PUBLIC DOCUMENT . . . . No. 33.

TENTH ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

STATE AGRICULTURAL EXPERIMENT STATION

AT

AMHERST, MASS.

1892.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 Post Office Square.
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18 Post Office Square.
1893.

Commonwealth of Massachusetts.

Boston, Jan. 11, 1893.

To the Honorable Senate and House of Representatives.

In accordance with chapter 212 of the Acts of 1882 I have the honor to present the Tenth Annual Report of the Board of Control of the State Agricultural Experiment Station.

WM. R. SESSIONS,

Secretary.

MASSACHUSETTS STATE

AGRICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

BOARD OF CONTROL, 1892.

HIS EXCELLENCY WILLIAM E. RUSSELL,
Governor of the Commonwealth, President ex officio.

W. H. BOWKER of Boston, ... Term expires, 1895.
C. L. HARTSHORN of Worcester, ... Term expires, 1894.
Appointed by the State Board of Agriculture.

J. H. DEMOND of Northampton, ... Term expires, 1896.
T. P. ROOT of Barre, ... Term expires, 1893.
Appointed by the Board of Trustees of the Massachusetts Agricultural College.

F. H. APPLETON of Peabody, ... Term expires, 1894.
Appointed by the Massachusetts Society for Promoting Agriculture.

W. H. PORTER of Agawam, ... Term expires, 1895.
Appointed by the Massachusetts State Grange.

WM. C. STRONG of Newton Highlands, . . Term expires, 1894.
Appointed by the Massachusetts Horticultural Society.

H. H. GOODELL, A.M., LL.D., Amherst,
President of the Massachusetts Agricultural College.

C. A. GOESSMANN, Ph D., LL D., Amherst,
Director of the Station.

WM. R. SESSIONS, Hampden,
Secretary of the State Board of Agriculture.

WM. R. SESSIONS, Hampden,
Secretary and Auditor.

C. A. GOESSMANN, Amherst,
Treasurer.

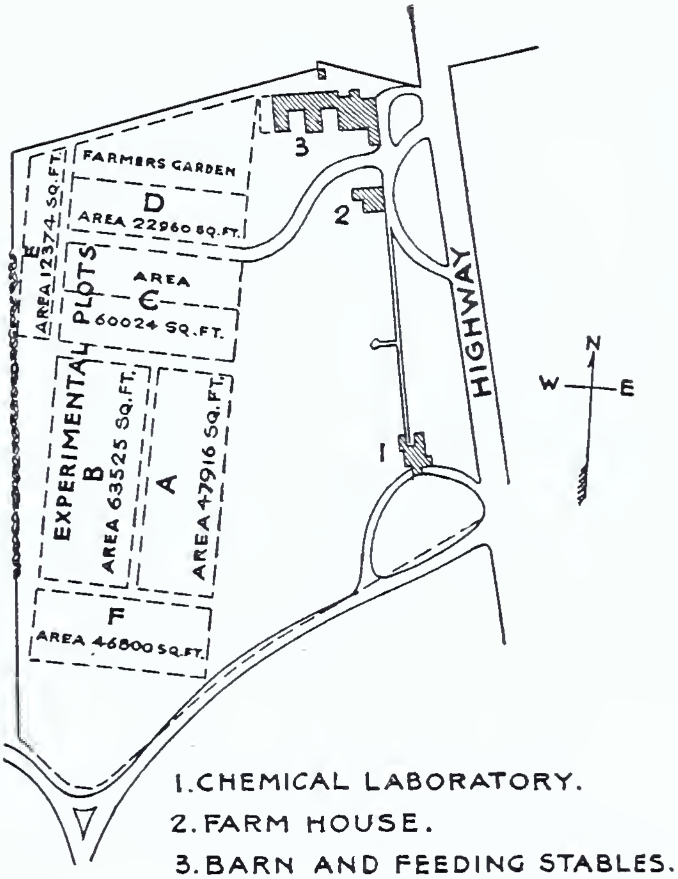
STATION STAFF.

C. A. GOESSMANN, Ph.D., LL.D., *Director and Chemist*, . Amherst.
J. B. LINDSEY, Ph.D., *Associate Chemist (Feeding Department)*, Amherst.
J. E. HUMPHREY, B.S.,* *Vegetable Physiologist (Mycologist)*, . Amherst.

ASSISTANTS.

R. B. MOORE, B.S.,†	*General and Analytical Chemistry.*
C. S. CROCKER, B.S., ...	" " " "
H. D. HASKINS, B.S., ...	" " " "
C. H. JONES, B.S., ...	" " " "
R. H. SMITH, B.S., ...	" " " "
E. B. HOLLAND, B.S., ...	" " " "
F. L. ARNOLD, B.S., ...	*Field Experiments.*
C. H. JOHNSON, B.S., ...	*Stock Feeding.*
DAVID WENTZELL, ...	*Farmer.*

* Resigned Jan. 1, 1893. † Resigned July 1, 1892.



·MAP·OF·LAND·LEASED·TO·THE·
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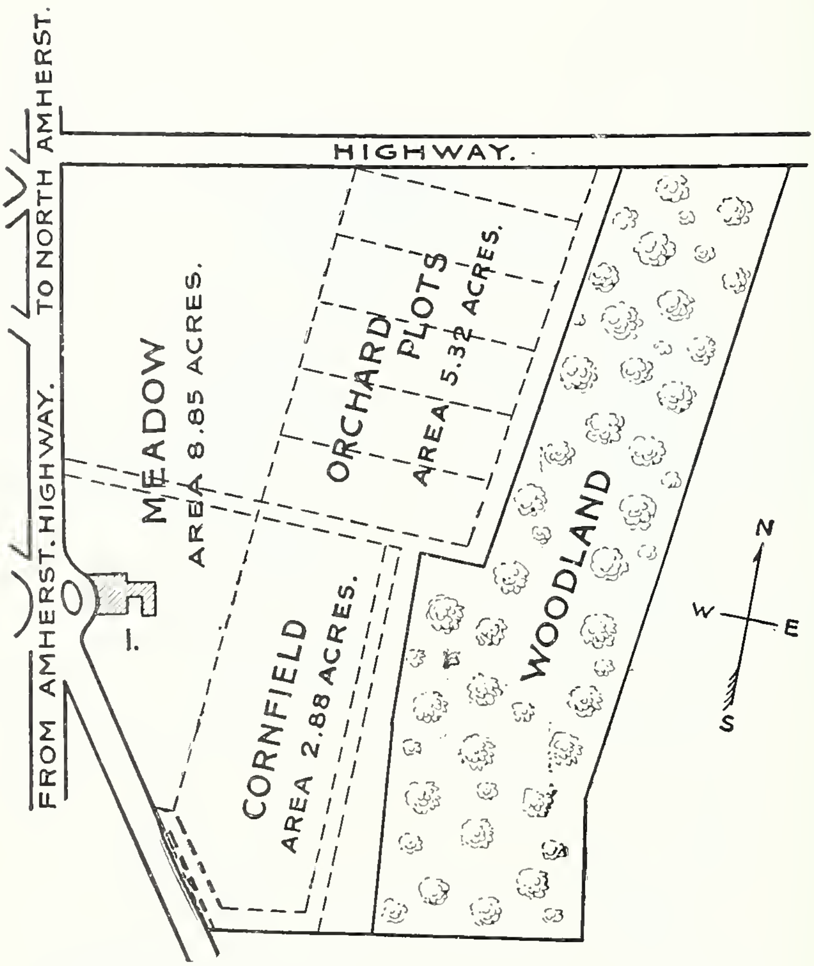
·FROM·THE·
·AGRICULTURAL·COLLEGE·FARM·
·WEST·OF·THE·HIGHWAY·
·AREA·TAKEN··17.72·ACRES·



I. AGRICULTURAL & PHYSIOLOGICAL LABORATORY.

MAP · OF · LAND · LEASED · TO · THE
MASSACHUSETTS · EXPERIMENT · STATION
· FROM · THE ·
AGRICULTURAL · COLLEGE · FARM
EAST · OF · THE · HIGHWAY
AREA · TAKEN · 30.52 · ACRES

TENTH ANNUAL REPORT OF THE DIRECTOR

OF THE

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

To the Honorable Board of Control.

GENTLEMEN: — The general condition of the State Agricultural Experiment Station may be considered to-day to be as satisfactory as at the close of the preceding year.

The buildings are on the whole in a fair state of preservation, considering their respective ages and previous conditions.

The arrangements for experiments in stock feeding have been improved in various directions, to provide for actual trials regarding the rate of digestibility of some new feed stuffs.

The number of silos has been increased to three, to admit of contemporaneous observations with different kinds of ensilage.

The outfit in apparatus of the chemical laboratory has been materially enlarged, to meet the growing demand for the analyses of dairy products, of imitations of butter, and of commercial feed stuffs.

A favorable season has contributed largely towards a satisfactory termination of a series of field experiments.

The different lines of observation from time to time presented for your consideration and endorsement have received their due attention to the full extent of existing resources, and as far as circumstances have rendered it practicable.

The co-operative tests in the vegetation house regarding the effect of different kinds and combinations of plant food

on the general character of certain field and garden crops, as well as on certain characteristics of the roots of leguminous plants, have added a new and interesting feature to the work of the station.

Prof. J. E. Humphrey has continued his observations regarding certain diseases of garden crops and fruits. A description of his work concerning some diseases of the cucumber, the black-knot of the plum, etc., accompanied by interesting illustrations, form a part of this report, Part II., 10.

Dr. J. B. Lindsey, a graduate of the Massachusetts Agricultural College, and former assistant in the Massachusetts State Experiment Station, who has lately closed a three-years course of study at the University of Göttingen and Zurich, and whose services have been secured by a vote of the Board at the July meeting, has entered upon his duties as associate chemist. The supervision and management of the stock-feeding department has been assigned to him as his special duty.

The work carried on at the station during the past year, 1892, has been reported in detail upon the succeeding pages in the following order: —

Part I.

On Feeding Experiments.

I. Feeding experiments with milch cows (two).

1. Winter feeding experiments with milch cows: —
   Dent corn *vs.* sweet corn.
   Corn meal *vs.* maize feed (Chicago).
2. Summer feeding experiments with milch cows: —
   Green feed: Rye, Canada peas and oats, summer vetch and oats, fodder corn and serradella.
   Grain feed: Wheat bran, Buffalo gluten feed, cotton-seed meal.
3. Creamery record of the station for 1891 and 1892.
4. Analyses of milk of different breeds of cows by Babcock mode.
5. Discussion on fodder articles and fodder supplies: —
   Home-raised fodder articles
   Commercial feed stuffs.
6. Analyses of fodder articles made at the station in 1892.

II. Feeding experiments with steers (two).
III. Feeding experiments with lambs.
IV. Feeding experiments with pigs (two).
V. Compilation of the amount of digestible nutrients consumed daily in the different feeding experiments made at the station, 1886–92, by Dr. J. B. Lindsey: —

1. Milch cows.
2. Steers.
3. Lambs.

Part II.

On Field Experiments and Observations in Vegetable Physiology and Pathology.

1. Field experiments to ascertain the effect of the exclusion of every form of nitrogen containing manurial matter from the fertilizer applied for the production of a leguminous crop, soja bean, on its yield per acre (Field A).
2. Field experiments with prominent varieties of grasses and with grass mixtures under fairly corresponding circumstances (Field B).
3. Field experiments regarding the effect of different combinations of commercial fertilizers on the yield of some prominent garden crops (Field C).
4. Observations regarding the adaptation of a variety of more or less reputed fodder plants new to our section of the country (Field D).
5. Field experiments with different commercial phosphates to study the economy of using the cheaper natural phosphates or the more costly acidulated phosphates (Field F).
6. Field experiments with mixed forage crops for green fodder and hay, vetch and oats, Canada peas and oats, soja bean, serradella, fodder corn (Fields G, H and I).
7. Observations on permanent grass lands (meadows).
8. Report on general farm work.
9 Report of Prof. James E. Humphrey on various diseases of plants, with observations in the field and vegetation house.

Part III.

Special Work in the Chemical Laboratory.

I. Communication on commercial fertilizers.

1. General introduction.
2. Laws for the regulation of trade in commercial fertilizers.
3. List of licensed manufacturers and dealers from May 1, 1892, to May 1, 1893.
4. Analyses of licensed fertilizers (185).
5. Analyses of commercial fertilizers and manurial substances sent on for examination (114).
6. Miscellaneous analyses (9).

II. Analyses of milk sent on for examination (113).

III. Analyses of water sent on for examination (109).

IV. Compilation of analyses made at Amherst, Mass., of agricultural chemicals and refuse materials used for fertilizing purposes.

V. Compilation of analyses made at Amherst, Mass., of fodder articles, fruits, sugar-producing plants, dairy products, etc.

Meteorological Observations.

The periodical publications of the station have been as frequent as in preceding years; four bulletins, from ten to eleven thousand copies each, and eight circulars of official analyses, seven thousand copies each. The interest in these publications is steadily increasing on the part of farmers, and the growing interest of the press is well illustrated by our numerous exchanges of periodical publications from home and abroad, as may be seen from a subsequent statement.

It gives me pleasure, before concluding, to express to you my due appreciation of the faithful and substantial support I have received from all parties engaged with me in the work accomplished at the station. With the assurance of my sincere thanks for your kind encouragement and indulgence, permit me to sign,

Yours very respectfully,

C. A. GOESSMANN,

Director of the Massachusetts State Agricultural Experiment Station.

PART I.

ON

FEEDING EXPERIMENTS.

I. Feeding Experiments with Milch Cows (two).

II. Feeding Experiments with Steers (two).

III. Feeding Experiments with Lambs.

IV. Feeding Experiments with Pigs (two).

V. Compilation of the Amount of Digestible Nutrients consumed Daily in the Different Feeding Experiments.

I.

FEEDING EXPERIMENTS WITH MILCH COWS (TWO).

1891–92.

1. Winter feeding experiments with milch cows: —

   Dent corn *vs.* sweet corn.
   Corn meal *vs.* maize feed (Chicago).

2. Summer feeding experiments with milch cows: —

   Green feed: Rye, Canada peas and oats, summer vetch and oats, fodder corn and serradella.
   Grain feed: Wheat bran, Buffalo gluten feed, cotton-seed meal.

3. Creamery record of the station for 1891 and 1892.
4. Analyses of milk of different breeds of cows by Babcock's mode.
5. Discussion on fodder articles and fodder supplies.

   Home-raised fodder articles.
   Commercial feed stuffs.

6. Analyses of fodder articles made at the station in 1892.

Introduction. — From preceding annual reports it may be noticed that of late our attention has been directed towards actual feeding trials with a series of concentrated commercial feed stuffs comparatively new in our local markets. Their more general appearance in recent times rendered it desirable, in the interest of our dairy industry, to ascertain their comparative feeding effects, as well as their special economical merits, in our present conditions of food supplies for the production of milk and of meat.

These articles were as a rule compared with each other as well as with other standard feed stuffs, as far as practicable under otherwise corresponding circumstances. They were usually fed in connection with the same kinds of grain feed and of coarse fodder articles.

The results obtained with Chicago gluten meal, old and

new process linseed meal, dried brewer's grain when fed in connection with corn meal or corn and cob meal or wheat bran or cotton-seed meal, or as substitutes of one or the other of these articles, have already been described in previous reports (VIII. and IX.).

During our last trials Chicago maize feed and Buffalo gluten feed have served as a new constituent of our grain feed ration for all classes of animals.

It has been our aim to secure genuine articles of both descriptions. The exceptionally high price of corn meal at the beginning of the year (thirty dollars a ton) rendered it advisable to look for some cheaper suitable commercial feed stuff, which might serve, in combination with other current, concentrated commercial feed stuffs, as a substitute for the former. Our results are on the whole quite encouraging, as may be seen from an examination of our subsequently described feeding experiments with various kinds of animals.

1. Winter Feeding Experiments with Milch Cows.

November, 1891, to March, 1892.

[Dent corn *vs.* sweet corn; corn meal *vs.* maize feed (Chicago).]

The experiments here under discussion were planned for the purpose of comparing the food value of a reputed variety of "dent corn" with that of a standard variety of "sweet corn," when used as the principal coarse fodder constituent in the daily diet of milch cows, either in the form of "ensilage," or, in a more advanced state of growth, in that of "stover." "Pride of the North" was selected as the representative of dent corns, and "Stowell's Evergreen" as that of sweet corns; both kinds of corn were used in all cases in corresponding stages of growth.

The exceptionally high market price of the corn meal at the beginning of our experiment (thirty-one dollars per ton of two thousand pounds) rendered its substitution in the daily diet of milch cows desirable for economical reasons. The Chicago variety of "maize feed" was chosen for that purpose. This comparatively new feed stuff is one of the waste products of corn obtained in connection with the manufacture of glucose sugar. The "maize feed" sold at

the time at twenty-five dollars per ton of two thousand pounds. The commercial value of its fertilizing constituents, nitrogen, phosphoric acid and potash exceeded those contained in the corn meal from six to seven dollars per ton, making a difference at the time of twelve dollars in the *net cost* of both kinds of fine or grain feed. A successful attempt at using "maize feed" in place of corn meal in the daily diet of milch cows could not fail to secure a material reduction in *the net cost* of the grain feed portion of the *daily fodder ration.*

From six to eight cows, grades of various descriptions and of different milking periods, were selected for the trial. Some of these animals served a shorter period than others, on account of a too far advanced stage of lactation. Our record on this occasion is confined to four cows, which took part, with but one exception, from the beginning of observation.

1. History of Cows.

Name of Cow.	Breed.	Age (Years).	Last Calf dropped.	Daily Yield of Milk at Beginning of Trial (Quarts).	Number of Months on Trial.
Clarissa, .	Grade Shorthorn, .	8	June 2, 1891,	7–8	4
Cora, .	Grade Jersey, .	8	Mar. 14, 1891,	9–10	5
Lucy, .	Grade Ayrshire, .	6	Apr. 16, 1891,	11–12	5
Gem, .	Grade Shorthorn, .	5	Dec. 6, 1891,	14–15	$3\frac{1}{2}$

2. Description of Fodder Articles.

The *grain feed portion* of the daily diet consisted at different times either of *corn meal*, *wheat bran* and *maize feed* (Chicago), or of *maize feed*, *wheat bran* and *cotton-seed meal.*

The mechanical condition of these various feed stuffs was good, and their chemical composition in every case a fair one, as may be seen from an abstract of the average result of our analyses. The Chicago maize feed was of a somewhat coarser texture than either of the other articles. It represents the dried grain residue of the maize kernels after the principal part of its starchy material has been removed, and contains more or less of the broken-up skins of the kernels.

Analyses of Fine Feed used.

[Grain Feed]

Food Analyses.	Corn Meal.	Wheat Bran.	Maize Feed.	Cotton-seed Meal.
Moisture at 100° C.,	13.26	10.01	8.70	7.05
Dry matter,	86.74	89.99	91.30	92.95
	100.00	100.00	100.00	100.00
Analyses of Dry Matter.				
Crude ash,	1.72	6.58	0.78	5.40
" cellulose,	2.28	11.77	7.97	6.15
" fat,	4.90	5.04	7.37	13.82
" protein,	12.94	18.06	27.55	38.79
Non-nitrogenous extract matter,	78.16	58.55	56.33	35.84
	100.00	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4¼ cents, per pound]

Fertilizer Analyses.	Corn Meal.	Wheat Bran.	Maize Feed.	Cotton-seed Meal.
Moisture,	13.26	10.01	8.70	7.05
Nitrogen,	1.79	2.60	4.03	5.77
Phosphoric acid,	0.71	2.85	0.70	2.33
Potassium oxide,	0.44	1.63	0.43	1.72
Valuation per 2,000 pounds,	$6.55	$12 40	$13 25	$21 42

The coarse feed-stuffs used in the daily diet consisted on this occasion either of a good English hay with sugar beets, or of one-fourth of a daily ration of a good English hay with all the ensilage the animal would consume, or of a well-cured corn stover. The hay consumed throughout the experiment was of the same fair quality.

The corn ensilage was obtained in part from a dent corn variety, "Pride of the North," and in part from a sweet corn variety, "Stowell's Evergreen." The same varieties of corn furnished the corn stover. Both kinds of corn were of a corresponding stage of growth when secured for the

production of ensilage or of stover. In case of ensilage, the corn was cut in both cases when the kernels began to glaze; the whole plant was reduced to pieces from one to one and one-half inches in length, before being filled into the silo. The latter was filled as rapidly as the supply of material admitted. Both silos were covered in the same way (see previous report). They were of the same size and contained about the same quantity of cut ensilage corn (whole plant).

The corn stover was obtained in both instances from the matured crops, which were cut about ten days later than for ensilage. The ears were separated from the stalks and the latter carefully field-cured, and subsequently cut in a similar way as the ensilage for the silo, before being fed. The stover from sweet corn retained under otherwise corresponding circumstances more moisture than that from the dent corn; it was for this reason more liable to mould than the former. The ensilage from sweet corn was, however, fully equal in color and flavor to that from the dent corn. Both were highly relished by the animals on trial.

The chemical composition of the several coarse fodder articles used in our experiment is stated in the following tabular record: —

Analyses of Coarse Fodder Articles used.

Food Analyses.	Hay.	* Sweet Corn Stover.	† Dent Corn Stover.	* Sweet Corn Ensilage.	† Dent Corn Ensilage.	Sugar Beets.
Moisture at 100° C, .	9.72	41.62	20.10	84.30	79.92	85.27
Dry matter, . .	90.28	58.38	79.90	15.70	20.08	14.73
	100.00	100.00	100.00	100.00	100.00	100.00
Analyses of Dry Matter.						
Crude ash, . . .	6.43	9.76	6.12	6.32	4.99	5.95
" cellulose,. .	32.28	37.79	33.72	29.32	27.19	6.49
" fat, . . .	2.49	2.44	2.51	7.36	3.29	0.66
" protein, . .	9.54	6.08	7.75	7.86	8.29	10.97
Non-nitrogenous extract matter, . .	49.26	43.93	49.90	49.14	56.24	75.93
	100.00	100.00	100.00	100.00	100.00	100.00

* Stowell's Evergreen. † Pride of the North.

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

Fertilizer Analyses.	Hay.	Sweet Corn Stover.	Dent Corn Stover.	Sweet Corn Ensilage.	Dent Corn Ensilage.	Sugar Beets.
Moisture,	9.72	41.62	20.10	84.30	79.92	85.27
Nitrogen,	1.38	0.57	0.99	0.20	0.27	0.26
Phosphoric acid,	0.36	0.20	0.29	0.087	0.14	0.10
Potassium oxide,	1.57	1.00	1.40	0.41	0.33	0.48
Valuation per 2,000 pounds,	$5 95	$2 83	$4 55	$1 06	$1 26	$1 32

3. *Mode of Feeding.*

The time occupied by the experiment is divided into five feeding periods, varying from two to five weeks in length. The *total weight* of the *daily grain feed ration remained the same throughout the entire trial*, namely, *nine pounds*. This amount consisted during the first feeding period, November 8 to November 23, of three pounds each of maize feed (Chicago), wheat bran and corn meal, and during the remaining four feeding periods of three pounds each of Chicago maize feed, wheat bran and cotton-seed meal. One-half of the daily grain feed ration was fed at the time of milking in the morning with one-half of the coarse feed, and the other half with the remainder of the coarse feed at the milking time toward evening.

The *total* amount of the daily *coarse feed ration* depended on the individual appetite of the animals, and on the character of the fodder articles fed. During the first feeding period, when English hay and sugar beets constituted the daily coarse feed ration, the daily consumption of roots was limited per head in all cases to fifteen pounds, while the daily quantity of hay consumed was decided by the appetite of the animal, varying in case of different animals from twelve to sixteen pounds.

During the second and the third feeding periods nothing but corn stover served as coarse feed in the daily diet. The amount of stover from Stowell's Evergreen sweet corn con-

sumed per day has varied in case of different animals from twelve and one-half to seventeen pounds per head; while the daily consumption of the stover obtained from the dent corn variety, Pride of the North, has varied per head from ten to thirteen and one-half pounds. The difference in the amount of both kinds of stover consumed is evidently mainly due to their different state of moisture, as may be noticed by comparing in both cases the total amount of dry matter contained in the daily diet consumed during the second and third feeding periods.

Corn ensilage and English hay constituted the coarse fodder of the daily diet during the fourth and fifth feeding periods. The amount of English hay fed per day in this connection was limited in all cases to five pounds per head; that of both kinds of the ensilage was governed by the appetite of each animal. Dent corn ensilage was fed in connection with English hay, as stated during the fourth feeding period, and the ensilage from the sweet corn during the fifth.

The daily consumption of the ensilage from the sweet corn varied per head in case of different animals from twenty-four to forty-three pounds, and that of the ensilage from the sweet corn from thirty-five to fifty-three pounds. This difference in the weights of both kinds of ensilage consumed in case of the same animal, is materially due to the same circumstance as has been pointed out previously with reference to similar facts noticed concerning the consumption of both kinds of corn stover. The ensilage of the dent corn contains twenty per cent. of dry vegetable matter and eighty per cent. of water, and the ensilage of the sweet sixteen per cent. of dry vegetable matter and eighty-four per cent. of water. The cows were watered twice a day, about two hours after feeding time.

The daily fodder rations below described represent the *average composition* of the daily diet used per head during the stated five succeeding feeding periods.

Average Composition of the Daily Fodder Rations used during the Five Successive Feeding Periods (1891–92).

I. *November 8 to November 23.*

Corn meal (pounds),	3.00
Wheat bran,	3.00
Maize feed,	3.00
Hay,	14.35
Sugar beets,	15.00
Nutritive ratio,	1 : 6.65
Total cost (cents),	26.18
Manurial value obtainable,	9.48
Net cost,	16.70

II. *December 4 to December 23.*

Wheat bran (pounds),	3.00
Maize feed,	3.00
Cotton-seed meal,	3.00
Sweet corn stover,*	14.56
Nutritive ratio,	1 : 4.61
Total cost (cents),	15.04
Manurial value obtainable,	7.29
Net cost,	7.75

III. *December 26 to January 13.*

Wheat bran (pounds),	3.00
Maize feed,	3.00
Cotton-seed meal,	3.00
Dent corn stover,†	12.06
Nutritive ratio,	1 : 4.63
Total cost (cents),	14.42
Manurial value obtainable,	7.84
Net cost,	6.58

IV. *January 17 to February 23.*

Wheat bran (pounds),	3.00
Maize feed,	3.00
Cotton-seed meal,	3.00
Hay,	5.00
Dent corn ensilage,	32.00
Nutritive ratio,	1 : 4.64
Total cost,	19.15
Manurial value obtainable,	8.46
Net cost,	10.69

V. *February 27 to March 23.*

Wheat bran (pounds),	3.00
Maize feed,	3.00
Cotton-seed meal,	3.00
Hay,	5.00
Sweet corn ensilage,	41.39
Nutritive ratio,	1 : 4.80
Total cost (cents),	20.32
Manurial value obtainable,	8.60
Net cost,	11.72

* Stowell's Evergreen.

† Pride of the North.

4. *Cost of Feed.*

The commercial valuation of the previously described daily average fodder rations during the five feeding periods of our experiment is based on the below-stated contemporary local price of the various fodder articles used in their composition: —

Local Market Cost per Ton of the Various Articles of Fodder used.

Corn meal,	$31 00
Wheat bran,	22 00
Maize feed,	25 00
Cotton-seed meal,	29 00
English hay,	15 00
Sweet corn stover,	5 00
Dent corn stover,	5 00
Sweet corn ensilage,	2 50
Dent corn ensilage,	2 50
Sugar beets,	5 00

Summary of Cost of the Above-stated Average Daily Fodder Rations used.

[Cents.]

	Feeding Periods.				
	I.	II.	III.	IV.	V.
Total cost,	26.18	15.04	14.42	19.15	20.32
Manurial value obtainable,	9.48	7.29	7.84	8.46	8.60
Net cost,*	16.70	7.75	6.58	10.69	11.72

* Allowing eighty per cent of the manurial value obtainable from the feed consumed.

Total cost of each daily ration represents the sum of the market cost of the quantity of the different fodder articles contained in that particular daily diet.

Net cost of a fodder article represents the cost of the article, less the commercial value of that portion of the various quantities of the different essential fertilizing constituents they contain which passes into the animal excretions, liquid and solid, and becomes thus available in the manurial refuse resulting from its consumption. The value of the manurial refuse obtainable from one and the same

kind and quality of fodder article depends on the function, the kind and the age of the animal which consumes it. In case of milch cows it is conceded that an allowance of a loss of twenty per cent. covers the amount of nitrogen, phosphoric acid and potash which passes into the milk produced, and is thus lost as a manurial resource of the farm.

As our various fodder articles quite frequently differ widely from each other with reference to the amount of nitrogen, phosphoric acid and potash they contain, it is but natural that the obtainable manurial value of our different fodder articles under otherwise corresponding circumstances must differ also more or less seriously. The more phosphoric acid, potash and in particular nitrogen a given quantity of a fodder article contains, the more valuable, considered from a commercial stand-point, is the manurial refuse resulting from its use. The subsequent abstract of our fertilizer analyses of the different fodder articles used on the present occasion may well serve as an illustration of the previous statements.

Commercial Valuation of Essential Constituents contained in the Various Articles of Fodder used.

[Nitrogen 15 cents, phosphoric acid $5\frac{1}{2}$ cents, potassium oxide $4\frac{1}{2}$ cents, per pound.]

FERTILIZER ANALYSES.	Corn Meal.	Wheat Bran.	Maize Feed (Chicago).	Cotton-seed Meal.	English Hay.	Sweet Corn Stover.	Dent Corn Stover.	Sweet Corn Ensilage.	Dent Corn Ensilage.	Sugar Beets.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Moisture,	13.26	10.01	8.70	7.05	9.72	41.62	20.10	84.30	79.92	85.27
Nitrogen,	1.79	2.60	4.03	5.77	1.38	0.57	0.99	0.20	0.27	0.26
Phosphoric acid,	0.71	2.85	0.70	2.33	0.36	0.20	0.29	0.087	0.14	0.10
Potassium oxide,	0.44	1.63	0.43	1.72	1.57	1.00	1.40	0.41	0.33	0.48
Valuation per 2,000 pounds,	$6 55	$12 40	$13 25	$21 42	$5 95	$2 83	$4 55	$1 06	$1 26	$1 32

Per Ton of 2,000 Pounds.

Market cost,	$31 00	$22 00	$25 00	$29 00	$15 00	$5 00	$5 00	$2 50	$2 50	$5 00
Manurial value obtainable,*	5 24	9 92	10 60	17 14	4 76	2 26	3 64	0 85	1 01	1 06
Net cost,	25 76	12 08	14 40	11 86	8 24	2 74	1 36	1 65	1 49	3 94

* Allowing a loss of twenty per cent. contained in the milk sold.

From previous discussions it will be noticed that the different fodder rations used during the five feeding periods of our last experiment varied seriously in regard to *market cost* as well as to *net cost*. To what particular circumstance this result is due deserves some special attention. Whether it is due to the cost of the grain feed or to that of the coarse feed, and to what extent in either case, is shown in the subsequent tabular statement.

Statement of the Cost of Fine and Coarse Feed Portion of the Daily Fodder Rations used.

Fine Feed.

[Cents.]

	Feeding Periods.				
	I.	II.	III.	IV.	V.
Total cost,	11.70	11.40	11.40	11.40	11.40
Manurial value obtainable,	3.90	5.65	5.65	5.65	5.65
Net cost,	7.80	5.75	5.75	5.75	5.75

Coarse Feed.

[Cents.]

	I.	II.	III.	IV.	V.
Total cost,	14.51	3.64	3.02	7.75	8.92
Manurial value obtainable,	5.65	1.65	2.20	3.30	3.45
Net cost,	8.86	1.99	0.82	4.45	5.47

The market cost of our grain feed ration is materially the same in all cases; the high manurial value of maize feed and cotton-seed meal (II., III., IV., V.), as compared with that of corn meal (I.), makes the net cost of the former two cents less than that of the latter. The pecuniary advantages arising from an intelligent use of corn stover and corn ensilage in the dairy industry, in place of English hay, deserve particular attention. In view of these results, it may not be out of place to repeat a former advice: —

"The high market price of two of our most prominent home-raised coarse fodder articles, first and second cut of upland meadow, English hay and rowen, affects seriously the degree of our financial results in the production of milk, as far as the cost of feed is concerned. We are in need of a cheaper source of supply of coarse fodder substances than

a considerable proportion of our grass lands, pastures and meadows, in their present state of productiveness, can claim to be. More satisfactory results can be obtained, no doubt, in many cases by turning indifferently yielding dry grass lands, if at all capable of higher cultivation, to account for the production of some other suitable fodder crops than grasses. The good services of dry fodder corn, corn stover and a good corn ensilage, for a more economical production of milk, are deservedly from day to day more generally recognized. However gratifying this fact will be considered, it is not advisable, in the light of past experience, in a general farm management to raise one fodder crop at the exclusion of all others, however lucrative at the time this practice may prove; such course can at best only offer a temporary relief. The introduction of a greater variety, in particular of annual reputed fodder crops, promises a more permanent improvement in fodder supply. Such course wherever adopted has not only resulted in cheapening the production of milk and beef, but has proved to be a most economical way to raise the general productiveness of farm lands to a higher standard."

Our local experience with a variety of annual leguminous fodder crops, as vetches, cow-peas, serradella and soja bean, has been very encouraging. The satisfactory results obtained in previous years are fully confirmed year after year. We are raising the present season vetch and oats, Canada peas and oats, soja beans and serradella, partly for green fodder and for ensilage, and partly for hay.

Quantity of Milk produced per Day (Quarts).

[One quart equals 2.15 pounds.]

	Feeding Periods.					General Average.	Extreme Variations.
	I.	II.	III.	IV.	V.		
Clarissa, .	7.18	5.76	4.88	4.52	–	5.59	3.72– 8.37
Cora, .	8.57	7.29	6.68	6.17	5.39	6.82	4.65– 9.77
Lucy, .	9.68	8.00	7.73	7.73	7.79	8.19	6.51–10.70
Gem,. .	–	13.46	–	13.18	12.31	12.98	11.63–15.11

Considering the period of lactation in the case of each animal, the decline in yield of milk as the time of observation

advances seems to be normal. Cow No. 4, "Gem," was somewhat indisposed during the third feeding period, refusing for a week or two to eat her customary amount of feed; the yield of milk fell off, and is for this reason not recorded here. As soon as she began to consume again the regular fodder ration, the yield of milk with reference to quantity was normal; yet its quality had suffered a serious change in solids, as will be noticed from the following record of analyses of morning's milk: —

Analyses of Milk during Different Feeding Periods.

[Per Cent.]

1891-92.	Clarissa.		Cora.		Lucy.		Gem.	
	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.
Period II.: —								
December 8, .	15.12	5.96	14.06	5.17	13.68	4.66	–	–
December 15, .	13.96	5.15	13.39	4.34	12.81	4.77	13.93	4.91
December 22, .	15.50	5.61	13.65	4.73	13.67	4.67	14.49	5.10
Period III.: —								
December 29, .	14.09	5.02	13.03	4.37	13.63	4.43	13.19	4.16
January 5, .	13.95	4.62	13.21	4.21	14.14	5.05	–	–
January 12, .	14.55	4.72	14.04	4.66	13.53	4.38	–	–
Period IV.: —								
January 19, .	13.96	4.66	13.77	4.69	14.04	5.42	11.63	3.48
January 26, .	13.19	4.11	12.71	4.15	13.63	4.79	11.11	3.38
February 2, .	13.93	4.47	13.97	4.72	13.84	4.73	11.94	3.55
February 9, .	14.07	5.18	13.06	4.34	14.50	5.32	11.64	3.49
February 16, .	13.29	4.57	13.63	4.77	14.16	5.18	12.06	3.58
February 22, .	13.89	4.92	14.05	4.84	13.65	4.56	12.06	3.56
Period V.: —								
March 1, .	–	–	13.38	4.45	13.82	4.51	12.23	3.56
March 8, .	–	–	14.00	4.80	14.10	5.08	12.15	3.66
March 15, .	–	–	14.34	5.41	12.82	4.09	11.99	3.56
March 22, .	–	–	13.83	4.67	14.11	4.78	11.60	3.27

Live Weight of Animals during the Feeding Periods.

[Pounds.]

	Feeding Periods.					Gain at Close.
	I.	II.	III.	IV.	V.	
Clarissa, ...	951	966	957	999	–	48
Cora, ...	1,062	1,042	1,051	1,062	1,069	7
Lucy, ...	850	815	816	808	804	—46
Gem, ...	–	869	–	856	865	—4

The general condition of the animals at the close of the observation was a satisfactory one.

Conclusions.

A careful consideration of the previously recorded results leads us to the following conclusions: —

1. The substitution of a ration composed of three pounds each of corn meal, maize feed and wheat bran, by one consisting of three pounds each maize feed, wheat bran and cotton-seed meal, *has in our case not materially changed the market cost of the grain feed ration, but reduced two cents its net cost, in consequence of the more valuable manurial refuse of the latter.*

2. The quantity and quality of milk has not been affected in any noticeable degree by the change in the grain feed ration in case of healthy animals.

3. The differences in the cost, *both market and net, of the different fodder rations, are in a controlling degree due to the cost of the different coarse fodder articles used, — a fact which has been repeatedly pointed out in previous communications.*

FEEDING RECORD.

Clarissa.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.										Total Amount of Dry Matter consumed per Day (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Corn Meal.	Wheat Bran.	Maize Feed.	Cotton-seed Meal.	Hay.	Sweet Corn Stover.	Dent Corn Stover.	Sweet Corn Ensilage.	Dent Corn Ensilage.	Beets.					
1891-92.															
Nov. 8 to Nov. 23,	3.00	3.00	3.00	-	16.00	-	-	-	-	15.00	24.68	7.18	3.44	1:6.71	951
Dec. 4 to Dec. 23,	-	3.00	3.00	3.00	-	17.05	-	-	-	-	18.18	5.76	3.16	1:4.90	966
Dec. 26 to Jan. 13,	-	3.00	3.00	3.00	-	-	13.28	-	-	-	18.84	4.88	3.86	1:4.78	957
Jan. 17 to Feb. 23,	-	3.00	3.00	3.00	5.00	-	-	-	43.32	-	21.43	4.52	4.74	1:4.96	999

Cora.

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Maize Feed.	Cotton-seed Meal.	Hay.	Sweet Corn Stover.	Dent Corn Stover.	Sweet Corn Ensilage.	Dent Corn Ensilage.	Beets.	Total Amount of Dry Matter consumed per Day (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal (Pounds).
Nov. 8 to Nov. 23,	3.00	3.00	3.00	-	11.73	-	-	-	-	15.00	20.83	8.58	2.43	1:6.41	1,062
Dec. 4 to Dec 23,	-	3.00	3.00	3.00	-	12.32	-	-	-	-	15.42	7.29	2.11	1:4.38	1,042
Dec. 26 to Jan. 13,	-	3.00	3.00	3.00	-	-	9.78	-	-	-	16.04	6.68	2.40	1:4.35	1,051
Jan. 17 to Feb. 23,	-	3.00	3.00	3.00	5.00	-	-	-	26.65	-	18.09	6.17	2.93	1:4.49	1,062
Feb. 27 to Mar. 23,	-	3.00	3.00	3.00	5.00	-	-	34.56	-	-	18.17	5.39	3.37	1:4.64	1,069

FEEDING RECORD — *Concluded.*

Lucy.

Feeding Periods.	Feed consumed (Pounds) per Day.										Total Amount of Dry Matter consumed per Day (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Corn Meal.	Wheat Bran.	Maize Feed.	Cotton-seed Meal.	Hay.	Sweet Corn Stover.	Dent Corn Stover.	Sweet Corn Ensilage.	Dent Corn Ensilage.	Beets.					
1891-92.															
Nov. 8 to Nov. 23,	3.00	3.00	3.00	-	15.33	-	-	-	-	15.00	24.08	9.69	2.49	1:6.69	850
Dec. 4 to Dec. 23,	-	3.00	3.00	3.00	-	13.47	-	-	-	-	16.09	8.00	2.01	1:4.51	815
Dec. 26 to Jan. 13,	-	3.00	3.00	3.00	-	-	13.11	-	-	-	18.70	7.43	2.52	1:4.76	816
Jan. 17 to Feb. 23,	-	3.00	3.00	3.00	5.00	-	-	-	23.68	-	17.49	7.73	2.26	1:4.41	808
Feb. 27 to Mar. 23,	-	3.00	3.00	3.00	5.00	-	-	37.20	-	-	18.58	7.79	2.39	1:4.70	804

Gem.

Feeding Periods.	Corn Meal.	Wheat Bran.	Maize Feed.	Cotton-seed Meal.	Hay.	Sweet Corn Stover.	Dent Corn Stover.	Sweet Corn Ensilage.	Dent Corn Ensilage.	Beets.	Total Amount of Dry Matter consumed per Day (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal (Pounds).
Dec. 10 to Dec. 23,	-	3.00	3.00	3.00	-	15.39	-	-	-	-	17.21	13.46	1.27	1:4.71	869
Dec. 26 to Jan. 13,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan. 17 to Feb 23,	-	3.00	3.00	3.00	5.00	-	-	-	34.35	-	19.64	13.18	1.49	1:4.71	856
Feb. 27 to Mar. 23,	-	3.00	3.00	3.00	5.00	-	-	53.40	-	-	21.12	12.31	1.71	1:5.09	865

Total Cost of Feed per Quart of Milk.

Clarissa.

Feeding Periods.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Maize Feed consumed (Pounds).	Total Amount of Cotton-seed Meal consumed (Pounds).	Total Amount of Hay consumed (Pounds).	Total Amount of Sweet Corn Stover consumed (Pounds).	Total Amount of Dent Corn Stover consumed (Pounds).	Total Amount of Sweet Corn Ensilage consumed (Pounds).	Total Amount of Dent Corn Ensilage consumed (Pounds).	Total Amount of Beets consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
1891-92.														
Nov. 8 to Nov. 23, .	107.75	7.18	45.00	45.00	45.00	–	240.00	–	–	–	–	225.00	$4 11	3.81
Dec. 4 to Dec. 23, .	109.50	5.76	–	57.00	57.00	57.00	–	327.00	–	–	–	–	2 99	2.73
Dec. 26 to Jan. 13, .	87.84	4.88	–	54.00	54.00	54.00	–	–	239.00	–	–	–	2 65	3.02
Jan. 17 to Feb. 23, .	167.25	4.52	–	111.00	111.00	111.00	185.00	–	–	–	1,603.00	–	7 61	4.55

Cora.

Feeding Periods.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Maize Feed consumed (Pounds).	Total Amount of Cotton-seed Meal consumed (Pounds).	Total Amount of Hay consumed (Pounds).	Total Amount of Sweet Corn Stover consumed (Pounds).	Total Amount of Dent Corn Stover consumed (Pounds).	Total Amount of Sweet Corn Ensilage consumed (Pounds).	Total Amount of Dent Corn Ensilage consumed (Pounds).	Total Amount of Beets consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
Nov. 8 to Nov. 23, .	128.70	8.58	45.00	45.00	45.00	–	176.00	–	–	–	–	225.00	$3 63	2.82
Dec. 4 to Dec. 23, .	138.50	7.29	–	57.00	57.00	57.00	–	234.00	–	–	–	–	2 76	1.99
Dec. 26 to Jan. 13, .	120.25	6.68	–	54.00	54.00	54.00	–	–	176.00	–	–	–	2 49	2.07
Jan. 17 to Feb. 23, .	228.29	6.17	–	111.00	111.00	111.00	185.00	–	–	–	986.00	–	6 84	2.99
Feb. 27 to Mar. 23, .	134.75	5.39	–	75.00	75.00	75.00	125.00	–	–	864.00	–	–	4 87	3.61

TOTAL COST OF FEED PER QUART OF MILK — *Concluded.*

Lucy.

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Maize Feed consumed (Pounds).	Total Amount of Cotton-seed Meal consumed (Pounds).	Total Amount of Hay consumed (Pounds).	Total Amount of Sweet Corn Stover consumed (Pounds).	Total Amount of Dent Corn Stover consumed (Pounds).	Total Amount of Sweet Corn Ensilage consumed (Pounds).	Total Amount of Dent Corn Ensilage consumed (Pounds).	Total Amount of Beets consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed to Production of One Quart of Milk (Cents).
1891-92.														
Nov. 8 to Nov. 23, .	145.35	9.69	45.00	45.00	45.00	-	230.00	-	-	-	-	225.00	$4 05	2.78
Dec. 4 to Dec. 23, .	152.00	8.00	-	57.00	57.00	57.00	-	256.00	-	-	-	-	2 81	1.85
Dec. 26 to Jan. 13, .	133.74	7.43	-	54.00	54.00	54.00	-	-	236.00	-	-	-	2 64	1.98
Jan. 17 to Feb. 23, .	286.00	7.73	-	111.00	111.00	111.00	185.00	-	-	-	876.00	-	6 71	2.35
Feb. 27 to Mar. 23, .	194.75	7.79	-	75.00	75.00	75.00	125.00	-	-	930.00	-	-	4 95	2.54

Gem.

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Maize Feed consumed (Pounds).	Total Amount of Cotton-seed Meal consumed (Pounds).	Total Amount of Hay consumed (Pounds).	Total Amount of Sweet Corn Stover consumed (Pounds).	Total Amount of Dent Corn Stover consumed (Pounds).	Total Amount of Sweet Corn Ensilage consumed (Pounds).	Total Amount of Dent Corn Ensilage consumed (Pounds).	Total Amount of Beets consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed to Production of One Quart of Milk (Cents).
Dec. 10 to Dec. 23, .	174.98	13.46	-	39.00	39.00	39.00	-	200.07	-	-	-	-	$1 98	1.13
Dec. 26 to Jan. 13, .	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jan. 17 to Feb. 23, .	487.66	13.18	-	111.00	111.00	111.00	185.00	-	-	-	1,270.95	-	7 20	1.48
Feb. 27 to Mar. 23, .	307.75	12.31	-	75.00	75.00	75.00	125.00	-	-	1,335.00	-	-	5 46	1.77

2. Summer Feeding Experiments with Milch Cows.

May, 1892, to September, 1892.

[Green feed: rye, Canada peas and oats, summer vetch and oats, fodder corn and serradella; grain feed: wheat bran, Buffalo gluten feed and cotton-seed meal.]

The experiment was instituted for the same purpose as our summer feeding experiments with milch cows in preceding years (since 1887). The main object of these experiments was to ascertain the fitness of a series of more or less reputed annual fodder crops to serve as the main coarse fodder supply for dairy cows during the growing season (June to October). Their selection as well as their mode of cultivation was largely governed by their special adaptation to the soil and to the period of season when needed to serve as green fodder.

The results obtained in previous years with vetch and oats, soja bean, Southern cow-pea and serradella have been already published. A larger number of different kinds of annual fodder crops have been cultivated during the past season than in preceding ones.

The whole season was divided into four feeding periods, as far as the green coarse fodder articles are concerned, namely, rye, peas and oats, vetch and oats, and fodder corn and serradella. The feeding of the rye and of the oats began when heading out; that of the peas, vetch and serradella when fairly in bloom; while that of the fodder corn began when the kernels commenced glazing.

One-fourth of a daily ration of rowen (second cut of upland meadows), five pounds, was fed in every instance, in common with the temporary green fodder ration.

The amount of rowen and of grain feed fed per day remained the same throughout the entire season. The daily consumption of the green fodder was governed by the individual appetite of the animal, and usually decreased with the advancing growth of the fodder plant.

The feeding of the green crops ceased as soon as they neared maturing. The part of the fodder crops which was

left unconsumed was cut and either turned into hay or placed in silos (see farther on for details under field experiments).

The grain feed ration remained the same throughout the entire season, Buffalo gluten feed, wheat bran and cotton-seed meal, three pounds of each daily per animal.

The cows used were, as has been the case in all our previous observations, grades of various descriptions and of a similar general character as on those occasions.

History of Cows.

Name of Cow.	Breed.	Age (Years).	Last Calf dropped.	Daily Yield of Milk at Beginning of Trial (Quarts).	Number of Months on Trial.
May,	Native,	*	Jan. 15, 1892,	11.71	6
Gem,	Grade Shorthorn,	5	Dec. 6, 1891,	13.53	6
Lucy,	Grade Ayrshire,	7	June 2, 1891,	10.88	6
Viola,	Native,	*	Feb. 10, 1892,	13.09	6
Anna,	Native,	*	Jan. 26, 1892,	11.94	6
Florence,	Grade Shorthorn,	*	May 13, 1892,	11.78	3½

The general management of this feeding experiment was the same as on preceding occasions.

Local Market Cost per Ton of the Various Articles of Fodder used.

Wheat bran,	$20 00
Gluten feed (Buffalo),	23 00
Cotton-seed meal,	28 00
Rowen,	15 00
Sugar beets,	5 00
Green rye,	2 50
Canada peas and oats (green),	2 75
Vetch and oats (green),	2 75
Corn fodder (green),	2 50
Serradella,	2 75

* Unknown.

Analyses of Fine Feed used.

[Grain Feed.]

FOOD ANALYSES.	Wheat Bran.	Gluten Feed.	Cotton-seed Meal.
Moisture at 100° C.,	10.01	6.33	7.05
Dry matter,	89.99	93.67	92.95
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	6.58	0.95	5.40
" cellulose,	11.77	5.76	6.15
" fat,	5.04	12.99	13.82
" protein,	18.06	25.75	38.79
Non-nitrogenous extract matter,	58.55	54.55	35.84
	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

FERTILIZER ANALYSES.	Wheat Bran.	Gluten Feed.	Cotton-seed Meal.
Moisture,	10.01	6.33	7.05
Nitrogen,	2.60	3.86	5.77
Phosphoric acid,	2.85	0.207	2.33
Potassium oxide,	1.63	0.04	1.72
Valuation per 2,000 pounds,	$12 40	$11 85	$21 42

Analyses of Coarse Fodder Articles used.

Food Analyses.	Rowen.	Sugar Beets.	Green Rye.	Canada-Peas and Oats.	Vetch and Oats.	Corn Fodder.	Serradella.
Moisture at 100° C., .	13.90	85.27	62.11	86.32	82.02	68.53	82.03
Dry matter, . .	86.10	14.73	37.89	13.68	17.98	31.47	17.97
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.							
Crude ash, . . .	8.28	5.95	5.27	6.90	9.31	5.68	9.59
" cellulose,. .	28.88	6.49	21.52	26.66	29.80	22.99	26.28
" fat, . . .	3.91	0.66	2.46	2.29	2.79	2.81	2.59
" protein, . .	13.45	10.97	5.38	16.01	16.77	6.22	15.13
Non-nitrogenous extract matter, . .	45.48	75.93	65.37	48.14	41.33	62.30	46.41
	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

Fertilizer Analyses.	Rowen.	Sugar Beets.	Green Rye.	Canada Peas and Oats.	Vetch and Oats.	Corn Fodder.	Serradella.
Moisture, . . .	13.90	85.27	62.11	86.32	82.02	68.53	82.03
Nitrogen, . . .	1.853	0.26	0.327	0.350	0.482	0.310	0.435
Phosphoric acid, .	0.464	0.10	0.150	0.130	0.132	0.055	0.126
Potassium oxide, .	1.966	0.48	0.734	0.415	0.418	0.149	0.379
Valuation per 2,000 pounds, . . .	$7 84	$1 32	$1 80	$1 56	$1 97	$1 12	$1 78

Average Composition of the Daily Fodder Rations used during the Five Successive Feeding Periods (1892).

I.		II.	
April 1 to May 21.		*May 27 to June 13.*	
Wheat bran (pounds),	3.00	Wheat bran (pounds),	3.00
Gluten feed (Buffalo),	3.00	Gluten feed (Buffalo),	3.00
Cotton-seed meal,	3.00	Cotton-seed meal,	3.00
Rowen,	5.00	Rowen,	5.00
Sugar beets,	15.00	Green rye,	16.22
Nutritive ratio,	1:4.48	Nutritive ratio,	1:4.82
Total cost (cents),	25.66	Total cost (cents),	16.43
Manurial value obtainable,	10.95	Manurial value obtainable,	8.21
Net cost,	14.71	Net cost,	8.22

III.		IV.	
June 18 to June 28.		*July 4 to August 3.*	
Wheat bran (pounds),	3.00	Wheat bran (pounds),	3.00
Gluten feed (Buffalo),	3.00	Gluten feed (Buffalo),	3.00
Cotton-seed meal,	3.00	Cotton-seed meal,	3.00
Rowen,	5.00	Rowen,	5.00
Canada peas and oats,	27.50	Vetch and oats,	37.71
Nutritive ratio,	1:3.78	Nutritive ratio,	1:3.75
Total cost (cents),	18.16	Total cost (cents),	19.57
Manurial value obtainable,	8.75	Manurial value obtainable,	10.02
Net cost,	9.41	Net cost,	9.55

V.	
September 17 to September 27.	
Wheat bran (pounds),	3.00
Gluten feed (Buffalo),	3.00
Cotton-seed meal,	3.00
Rowen,	5.00
Corn fodder,	30.00
Serradella,	20.00
Nutritive ratio,	1:5.52
Total cost (cents),	20.90
Manurial value obtainable,	9.81
Net cost,	11.09

Summary of Cost of the Above-stated Average Daily Fodder Rations used.

[Cents.]

	Feeding Periods.				
	I.	II.	III.	IV.	V.
Total cost,	25.66	16.43	18.16	19.57	20.90
Manurial value obtainable,	10.95	8.21	8.75	10.02	9.81
Net cost,*	14.71	8.22	9.41	9.55	11.09

* Allowing eighty per cent. of the manurial value of the feed consumed obtainable.

The local market cost of the daily grain feed ration is the same in all stated cases, 11.1 cents; while that of the daily coarse feed ration varies, 5.12 to 14.56 cents (see I. and II. periods). The obtainable manurial value varies from two-fifths to one-half of the total cost of the fodder ration.

Quantity of Milk produced per Day (Quarts).

[One quart equals 2.15 pounds.]

	Feeding Periods.					General Average.	Extreme Variations.
	I.	II.	III.	IV.	V		
May,	11.71	9.19	9.76	8.54	7.27	9.29	6.05–13.72
Gem,	13.53	11.53	11.34	11.21	11.21	11.76	9.53–16.28
Lucy,	10.88	8.27	9.44	8.98	8.22	9.16	6.74–12.54
Viola,	13.09	9.97	10.22	9.24	7.21	9.95	6.40–14.48
Anna,	11.94	9.19	9.79	8.33	6.94	9.24	6.51–13.14
Florence,	–	–	11.78	11.12	10.56	11.15	9.77–13.95

Cost of Feed per Quart of Milk.

[Cents.]

	Feeding Periods.					General Average.
	I.	II.	III.	IV.	V.	
May,	2.19	1.80	1.86	2.28	2.88	2.20
Gem,	1.89	1.45	1.61	1.75	1.87	1.71
Lucy,	2.36	2.02	1.93	2.19	2.54	2.21
Viola,	1.96	1.62	1.78	2.12	2.90	2.08
Anna,	2.15	1.76	1.86	2.35	3.01	2.02
Florence,	–	–	1.55	1.76	1.98	1.76

Analyses of Milk during Different Feeding Periods.

[Per Cent.]

1892.	May.		Gem.		Lucy.		Viola.		Anna.		Florence.	
	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.
Period I.: —												
April 19, ...	13.70	4.34	12.75	3.93	14.28	4.85	13.24	4.10	11.47	2.80	-	-
May 3, ...	12.96	3.91	12.20	3.61	13.60	4.51	12.50	3.71	10.71	2.73	-	-
May 17, ...	14.33	4.38	12.84	3.81	14.44	4.51	14.19	4.64	12.30	3.45	-	-
Period II.: —												
June 7, ...	15.08	4.90	13.30	4.04	14.45	4.82	14.07	4.61	12.67	3.55	12.07	3.34
Period III.: —												
June 28, ...	14.57	5.25	12.30	4.59	13.66	3.60	14.03	5.23	12.61	3.86	12.36	3.60
Period IV.: —												
July 12, ...	12.98	3.56	12.80	3.76	13.91	4.58	13.30	4.29	11.45	2.83	12.03	3.51
July 19, ...	12.55	2.92	12.86	3.75	14.18	4.92	12.69	3.70	11.33	2.42	12.17	3.16
July 29, ...	13.75	4.54	12.73	3.31	13.86	4.59	13.08	4.03	12.14	3.20	12.74	4.16

No analysis was made of the milk during the fifth feeding period.

Conclusion.

The results of our summer feeding experiments are on the whole very satisfactory, as may be seen from the summary of the yield of milk and of the cost of feed consumed per quart of milk produced. They furnish also an additional illustration of the statement that a well-regulated system of feeding our dairy stock during the summer secures the most satisfactory results, financially and otherwise.

FEEDING RECORD.

May.

FEEDING PERIODS.	Feed consumed (Pounds) per Day: Wheat Bran.	Gluten Feed.	Cotton-seed Meal.	Rowen.	Sugar Beets.	Green Rye.	Canada Peas and Oats.	Vetch and Oats.	Corn Stover.	Serradella.	Total Amount of Dry Matter consumed per Day (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal (Pounds).
1892.															
April 1 to May 21, .	3.00	3.00	3.00	15.00	15.00	–	–	–	–	–	23.43	11.71	2.00	1:4.48	888
May 27 to June 13, .	3.09	3.00	3.00	5.00	–	16.76	–	–	–	–	18.95	9.19	2.06	1:4.82	834
June 18 to June 28, .	3.00	3.00	3.00	5.00	–	–	27.50	–	–	–	16.36	9.76	1.68	1:3.78	845
July 4 to Aug. 3, .	3.00	3.00	3.00	5.00	–	–	–	37.07	–	–	19.27	8.54	2.26	1:3.70	853
Sept. 17 to Sept. 27, .	3.00	3.00	3.00	5.00	–	–	–	–	30.00	20.00	25.63	7.27	3.52	1:5.22	930

Gem.

FEEDING PERIODS.	Wheat Bran.	Gluten Feed.	Cotton-seed Meal.	Rowen.	Sugar Beets.	Green Rye.	Canada Peas and Oats.	Vetch and Oats.	Corn Stover.	Serradella.	Total Amount of Dry Matter consumed per Day (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal (Pounds).
April 1 to May 21, .	3.00	3.00	3.00	15.00	15.00	–	–	–	–	–	23.43	13.53	1.73	1:4.48	829
May 27 to June 13, .	3.00	3.00	3.00	5.00	–	18.23	–	–	–	–	19.51	11.53	1.69	1:4.83	865
June 18 to June 28, .	3.00	3.00	3.00	5.00	–	–	27.50	–	–	–	16.36	11.34	1.44	1:3.78	847
July 4 to Aug. 3, .	3.00	3.00	3.00	5.00	–	–	–	38.00	–	–	19.43	11.21	1.64	1:3.76	859
Sept. 17 to Sept. 27, .	3.00	3.00	3.00	5.00	–	–	–	–	30.00	20.00	25.63	11.21	2.28	1:5.22	900

FEEDING RECORD — *Concluded.*

Lucy.

Feeding Periods.	Feed consumed (Pounds) per Day. Wheat Bran.	Gluten Feed.	Cotton-seed Meal.	Rowen.	Sugar Beets.	Green Rye.	Canada Peas and Oats.	Vetch and Oats.	Corn Fodder.	Serradella.	Total Amount of Dry Matter consumed per Day (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal (Pounds).
1892.															
April 1 to May 21, .	3.00	3.00	3.00	15.00	15.00	–	–	–	–	–	23.43	10.88	2.15	1:4.48	817
May 27 to June 13, .	3.00	3.00	3.00	5.00	–	18.23	–	–	–	–	19.51	8.27	2.36	1:4.83	821
June 18 to June 28, .	3.00	3.00	3.00	5.00	–	–	27.50	–	–	–	16.36	9.44	1.73	1:3.78	795
July 4 to Aug. 3, .	3.00	3.00	3.00	5.00	–	–	–	38.00	–	–	19.43	8.98	2.16	1:3.76	821
Sept. 17 to Sept. 27, .	3.00	3.00	3.00	5.00	–	–	–	–	30.00	20.00	25.63	8.22	3 12	1:5.22	840

Viola.

Feeding Periods.	Wheat Bran.	Gluten Feed.	Cotton-seed Meal.	Rowen.	Sugar Beets.	Green Rye.	Canada Peas and Oats.	Vetch and Oats.	Corn Fodder.	Serradella.	Total Amount of Dry Matter consumed per Day (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal (Pounds).
April 1 to May 21, .	3.00	3.00	3.00	15.00	15.00	–	–	–	–	–	23.43	13.09	1.78	1:4.48	916
May 27 to June 13, .	3.00	3.00	3.00	5.00	–	13.94	–	–	–	–	17.88	9.97	1.79	1:4.80	875
June 18 to June 28, .	3.00	3.00	3.00	5.00	–	–	27.50	–	–	–	16.36	10.22	1.60	1:3.78	875
July 4 to Aug. 3, .	3.00	3.00	3.00	5.00	–	–	–	38.00	–	–	19.43	9.24	2.10	1:3.76	886
Sept. 17 to Sept. 27, .	3.00	3.00	3.00	5.00	–	–	–	–	30.00	20.00	25.63	7.21	3.55	1:5.22	925

Anna.

April 1 to May 21, .	3.00	3.00	3.00	15.00	15.00	–	–	–	–	–	23.43	11.94	1.97	1:4.48	969
May 27 to June 23, .	3.00	3.00	3.00	5.00	–	13.94	–	–	–	–	17.88	9.19	1.94	1:4.80	935
June 18 to June 28, .	3.00	3.00	3.00	5.00	–	–	27.50	–	–	–	16.36	9.79	1.67	1:3.78	945
July 4 to Aug. 3, .	3.00	3.00	3.00	5.00	–	–	–	37.60	–	–	19.36	8.33	2.08	1:3.75	947
Sept. 17 to Sept. 27, .	3.00	3.00	3.00	5.00	–	–	–	–	30.00	20.00	25.63	6.94	3.70	1:5.22	987

Florence.

June 18 to June 28, .	3.00	3.00	3.00	5.00	–	–	27.50	–	–	–	16.36	11.78	1.39	1:3.78	881
July 4 to Aug. 3, .	3.00	3.00	3.00	5.00	–	–	–	37.60	–	–	19.36	11.12	1.74	1:3.75	938
Sept. 17 to Sept. 27, .	3.00	3.00	3.00	5.00	–	–	–	–	30.00	20.00	25.63	10.56	2.43	1:5.22	935

TOTAL COST OF FEED PER QUART OF MILK.

May.

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Feed consumed (Pounds).	Total Amount of Cotton-seed Meal consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Amount of Sugar Beets consumed (Pounds).	Total Amount of Green Rye consumed (Pounds).	Total Amount of Canada Peas and Oats consumed (Pounds).	Total Amount of Vetch and Oats consumed (Pounds).	Total Amount of Corn Fodder consumed (Pounds).	Total Amount of Serradella consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
1892.														
April 1 to May 21,	585.47	11.71	150.00	150.00	150.00	750.00	750.00	–	–	–	–	–	$12 83	2.19
May 27 to June 13,	156.16	9.19	51.00	51.00	51.00	85.00	–	285.00	–	–	–	–	2 81	1.80
June 18 to June 28,	97.56	9.76	30.00	30.00	30.00	50.00	–	–	275.00	–	–	–	1 82	1.86
July 4 to Aug. 3,	256.05	8.54	90.00	90.00	90.00	150.00	–	–	–	1112.00	–	–	5 84	2.28
Sept. 17 to Sept. 27,	72.67	7.27	30.00	30.00	30.00	50.00	–	–	–	–	300.00	200.00	2 09	2.88

Gem.

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Feed consumed (Pounds).	Total Amount of Cotton-seed Meal consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Amount of Sugar Beets consumed (Pounds).	Total Amount of Green Rye consumed (Pounds).	Total Amount of Canada Peas and Oats consumed (Pounds).	Total Amount of Vetch and Oats consumed (Pounds).	Total Amount of Corn Fodder consumed (Pounds).	Total Amount of Serradella consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
April 1 to May 21,	676.28	13.53	150.00	150.00	150.00	750.00	750.00	–	–	–	–	–	$12 83	1.89
May 27 to June 13,	196.05	11.53	51.00	51.00	51.00	85.00	–	310.00	–	–	–	–	2 84	1.45
June 18 to June 28,	113.37	11.34	30.00	30.00	30.00	50.00	–	–	275.00	–	–	–	1 82	1.61
July 4 to Aug. 3,	336.16	11.21	90.00	90.00	90.00	150.00	–	–	–	1140.00	–	–	5 88	1.75
Sept. 17 to Sept. 27,	112.09	11.21	30.00	30.00	30.00	50.00	–	–	–	–	300.00	200.00	2 09	1.87

Lucy.

April 1 to May 21,	543.95	10.88	150.00	150.00	150.00	750.00	750.00	-	-	-	-	-	$12 83	2.36
May 21 to June 13,	140.58	8.27	51.00	51.00	51.00	85.00	-	310.00	-	-	-	-	2 84	2.02
June 18 to June 28,	94.42	9.44	30.00	30.00	30.00	50.00	-	-	275.00	-	-	-	1 82	1.93
July 4 to Aug. 3,	269.30	8.98	90.00	90.00	90.00	150.00	-	-	-	1140.00	-	-	5 88	2.19
Sept. 17 to Sept. 27,	82.21	8.22	30.00	30.00	30.00	50.00	-	-	-	-	300.00	200.00	2 09	2.54

Viola.

April 1 to May 21,	654.65	13.09	150.00	150.00	150.00	750.00	750.00	-	-	-	-	-	$12 83	1.96
May 27 to June 13,	169.42	9.97	51.00	51.00	51.00	85.00	-	237.00	-	-	-	-	2 75	1.62
June 18 to June 28,	102.21	10.22	30.00	30.00	30.00	50.00	-	-	275.00	-	-	-	1 82	1.78
July 4 to Aug. 3,	277.21	9.24	90.00	90.00	90.00	150.00	-	-	-	1140.00	-	-	5 88	2.12
Sept. 17 to Sept. 27,	72.09	7.21	30.00	30.00	30.00	50.00	-	-	-	-	300.00	200.00	2 09	2.90

Anna.

April 1 to May 21,	597.09	11.94	150.00	150.00	150.00	750.00	750.00	-	-	-	-	-	$12 83	2.15
May 27 to June 13,	156.28	9.19	51.00	51.00	51.00	85.00	-	237.00	-	-	-	-	2 75	1.76
June 18 to June 28,	97.90	9.79	30.00	30.00	30.00	50.00	-	-	275.00	-	-	-	1 82	1.86
July 4 to Aug. 3,	249.88	8.33	90.00	90.00	90.00	150.00	-	-	-	1128.00	-	-	5 87	2.35
Sept. 17 to Sept. 27,	69.42	6.94	30.00	30.00	30.00	50.00	-	-	-	-	300.00	200.00	2 09	3.01

Florence.

June 18 to June 28,	117.79	11.78	30.00	30.00	30.00	50.00	-	-	275.00	-	-	-	$1 82	1.55
July 4 to Aug. 3,	333.60	11.12	90.00	90.00	90.00	150.00	-	-	-	1128.00	-	-	5 87	1.76
Sept. 17 to Sept. 27,	105.58	10.56	30.00	30.00	30.00	50.00	-	-	-	-	300.00	200.00	2 09	1.98

3. Creamery Record of the Station for 1891 and 1892.

The cost of feed consumed is based on the market price as stated in the subsequent table. The valuation of the whole milk is taken at three cents per quart. The estimates of the value of fertilizing ingredients contained in the feed are based on those given in the following table: —

Local Market Cost per Ton of the Various Articles of Fodder used.

Corn meal,	$29 50
Wheat bran (in 1891, $21),	20 00
Gluten meal,	27 50
Gluten feed,	23 00
Maize feed,	25 00
Old-process linseed meal,	26 00
Cotton-seed meal,	28 00
Brewers' grain,	23 00
Hay,	15 00
Rowen,	15 00
Green fodder corn,	2 50
Corn stover,	5 00
Corn ensilage,	2 50
Corn and soja bean ensilage,	3 50
Green rye,	2 50
Soja bean (green),	4 40
Canada peas and oats (green),	2 75
Vetch (green),	2 75
Vetch and oats (green),	2 75
Rape,	2 50
Serradella,	2 75
Sugar beets,	5 00
Cabbages,	2 50

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

	Nitrogen.	Phosphoric Acid.	Potassium Oxide.	Valuation per 2,000 Pounds.
Corn meal,	1.79	0.71	0.44	$6 55
Wheat bran,	2.60	2.85	1.63	12 40
Gluten meal,	5.22	0.40	0.05	16 15
Gluten feed,	3.86	2.07	0.04	13 89
Maize feed,	4.03	0.70	0.43	13 25
Old-process linseed meal,	5.33	1.64	1.16	18 84
Cotton-seed meal,	5.77	2.33	1.72	21 42
Brewers' grain,	3.299	1.192	1.466	12 53
Hay,	1.38	0.36	1.57	5 95
Rowen,	1.853	0.464	1.966	7 84
Green fodder corn,	0.31	0.055	0.149	1 12
Corn stover,	0.78	0.245	1.20	3 70
Corn ensilage,	0.235	0.113	0.37	1 16
Corn and soja bean ensilage,	0.708	0.42	0.444	2 99
Green rye,	0.327	0.15	0.734	1 80
Soja beans (green),	0.59	0.193	0.311	2 26
Canada peas and oats (green),	0.35	0.128	0.402	1 55
Vetch (green),	0.49	0.133	0.425	2 00
Vetch and oats (green),	0.482	0.132	0.418	1 97
Rape,	0.46	0.12	0.35	1 82
Serradella,	0.435	0.126	0.379	1 78
Sugar beets,	0.26	0.10	0.48	1 32
Cabbages,	0.30	0.11	0.43	1 41

The value of cream is that granted us from month to month by our local creamery association. The station has no other connection with the financial management of the creamery.

Our presentation of financial results is based on the local cost of feed alone, and does not consider interest on investment and labor involved, for the reason that approximate estimates on these points are in an exceptional degree dependent on quality of stock and varying local circumstances. The details are embodied in a few subsequent tables under the following headings: —

1. Statement of articles of fodder used.
2. Record of average quality of milk and fodder rations.
3. Value of cream at creamery basis of valuation.
4. Cost of skim-milk at the selling price of three cents per quart of whole milk.
5. Fertilizing constituents of cream.
6. Some conclusions suggested by the records.
7. Analyses of cream.
8. Average milk analyses for previous years.

1. *Statement of Articles of Fodder used during 1891 (Pounds).*

1891.	Corn Meal.	Wheat Bran.	Gluten Meal.	Maize Feed.	Old-process Linseed Meal.	Cotton seed Meal.	Brewers' Grain.	Hay.	Rowen.	Green Fodder Corn.	Corn Stover.	Mixed Ensilage.	Vetch and Oats.	Soja Beans.	Sugar Beets.	Cabbages.
January, ...	541.50	541.50	-	-	244.50	297.00	-	-	2,355.00	-	-	1,614.00	-	-	840.00	-
February, . . .	504.00	504.00	306.00	-	-	198.00	-	-	857.00	-	-	7,566.00	-	-	-	-
March, ...	558.00	558.00	450.00	-	-	108.00	-	-	169.00	-	2,153.50	1,269.00	-	-	-	-
April, ...	537.00	540.00	-	-	-	534.00	-	-	1,915.50	-	106.50	-	-	-	-	-
May, ...	558.00	558.00	450.00	-	-	108.00	-	-	3,295.00	-	-	-	-	-	-	-
June, ...	516.00	540.00	516.00	-	-	-	-	-	2,417.50	-	-	-	-	-	-	-
July, ...	555.00	180.00	555.00	-	-	-	378.00	-	1,052.00	-	-	-	7,285.00	-	-	-
August, ...	558.00	324.00	558.00	-	-	-	234.00	-	1,032.50	-	-	-	479.00	6,965.00	-	1,820.00
September, . . .	540.00	-	540.00	-	-	-	540.00	-	690.00	4,504.50	-	-	-	1,011.00	-	1,800.00
October, ...	558.00	-	222.00	-	-	-	558.00	2,673.00	-	-	-	-	-	-	680.00	1,560.00
November, . . .	546.00	423.00	-	442.00	-	18.00	141.00	2,588.00	-	-	-	-	-	-	2,610.00	-
December, . . .	-	555.00	-	555.00	-	549.00	-	102.00	-	-	2,676.00	-	-	-	-	-

1. Statement of Articles of Fodder used during 1892 (Pounds).

1892.	Wheat Bran.	Gluten Feed.	Maize Feed.	Cotton-seed Meal.	Hay.	Rowen.	Green Fodder Corn.	Corn Stover.	Corn Ensilage.	Green Rye.	Canada Peas and Oats.	Vetch.	Vetch and Oats.	Rape.	Serradella.	Sugar Beets.	Cabbages.
January, . .	523.50	-	523.50	523.50	570.00	-	-	714.00	3,768.00	-	-	-	-	-	-	-	-
February, .	516.00	-	516.00	516.00	870.00	-	-	-	6,292.00	-	-	-	-	-	-	-	-
March, . .	549.00	150.00	396.00	549.00	870.00	615.00	-	-	4,604.00	-	-	-	-	-	-	840.00	-
April, . .	450.00	450.00	-	450.00	-	2,250.00	-	-	-	-	-	-	-	-	-	2,250.00	-
May, . . .	465.00	465.00	-	465.00	-	1,855.00	-	-	-	850.00	-	-	-	-	-	1,500.00	-
June, . .	540.00	540.00	-	540.00	-	900.00	-	-	-	1,254.00	2,220.00	-	540.00	-	-	-	-
July, . .	558.00	558.00	-	558.00	-	930.00	-	-	-	-	-	-	6,776.00	-	-	-	-
August, . .	558.00	558.00	-	558.00	-	930.00	6,102.00	-	-	-	-	1,380.00	-	882.00	-	-	2,016.00
September, .	540.00	540.00	-	540.00	-	900.00	7,781.00	-	-	-	-	-	-	297.00	2,130.00	-	-
October, . .	558.00	558.00	-	558.00	-	270.00	1,119.00	-	-	-	-	-	-	162.00	1,008.00	-	180.00

2. *Record of Average Quality of Milk and of Fodder Rations (1891).*

1891.	Average Percentage of Solids in Milk.	Average Percentage of Fat in Milk.	Quarts of Milk required to make One Space of Cream.	Nutritive Ratio of Feed.	Feed consumed (Pounds) per Day.														
					Corn Meal.	Wheat Bran.	Gluten Meal.	Maize Feed.	Old-process Linseed Meal.	Cotton-seed Meal.	Brewers' Grain.	Hay.	Rowen.	Green Fodder Corn.	Corn Stover.	Corn and Soja Bean Ensilage.	Vetch and Oats.	Soja Beans.	Sugar Beets.
January,	14.99	5.19	1.54	1:4.83	3.00	3.00	-	-	3.00	-	-	-	18.00	-	-	-	-	-	-
				1:4.17	3.00	3.00	-	-	-	3.00	-	-	5.00	-	-	42.00	-	-	-
February,	14.71	5.09	1.76	1:4.17	3.00	3.00	-	-	-	3.00	-	-	5.00	-	-	42.00	-	-	-
				1:4.70	3.00	3.00	3.00	-	-	-	-	-	5.00	-	-	46.00	-	-	-
March,	14.82	5.00	1.62	1:6.74	3.00	3.00	3.00	-	-	-	-	-	-	-	14.00	-	-	-	-
April,	14.41	5.21	1.53	1:5.66	3.00	3.00	-	-	-	3.00	-	-	-	-	14.00	-	-	-	-
				1:4.49	3.00	3.00	-	-	-	3.00	-	-	18.00	-	-	-	-	-	-
May,	13.75	4.39	1.67	1:5.14	3.00	3.00	3.00	-	-	-	-	-	18.00	-	-	-	-	-	-
June,	-	-	1.76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
July,	13.41	4.18	1.78	1:6.17	3.00	-	3.00	-	-	-	3.00	-	5.00	-	-	-	47.00	-	-
August,	13.42	4.22	1.86	1:5.07	3.00	3.00	3.00	-	-	-	3.00	-	5.00	-	-	-	-	51.00	-
				1:4.76	3.00	-	3.00	-	-	-	-	-	5.00	-	-	-	-	47.00	-
September,	13.90	4.15	1.75	1:6.17	3.00	-	3.00	-	-	-	3.00	-	5.00	39.00	-	-	-	-	-
October,	14.52	4.63	1.72	1:5.79	3.00	-	3.00	-	-	-	3.00	16.00	-	-	-	-	-	-	-
				1:5.34	3.00	-	-	-	-	3.00	3.00	13.90	-	-	-	-	-	-	15.00
November,	-	-	1.76	1:6.65	3.00	3.00	-	3.00	-	-	-	14.35	-	-	-	-	-	-	15.00
December,	14.42	4.98	1.70	1:4.61	-	3.00	-	3.00	-	3.00	-	-	-	-	14.56	-	-	-	-
Averages,	14.24	4.70	1.73	1:5.28															

2. *Record of Average Quality of Milk and of Fodder Rations (1892).*

1892.	Average Percentage of Solids in Milk.	Average Percentage of Fat in Milk.	Quarts of Milk required to make One Space of Cream.	Nutritive Ratio of Feed.	Feed consumed (Pounds) per Day.													
					Wheat Bran.	Gluten Feed.	Maize Feed.	Cotton-seed Meal.	Hay.	Rowen.	Green Fodder Corn.	Corn Stover.	Corn Ensilage.	Green Rye.	Canada Peas and Oats.	Vetch and Oats.	Serradella.	Sugar Beets.
January,	13.75	4.55	1.73	1:4.63 -	3.00 3.00	- -	3.00 3.00	3.00 3.00	- 5.00	- -	- -	12.06 -	- 32.00	- -	- -	- -	- -	- -
February,	13.24	4.36	1.70	1:4.64	3.00	-	3.00	3.00	5.00	-	-	-	32.00	-	-	-	-	-
March,	12.98	4.10	1.58	1:4.81	3.00	-	3.00	3.00	5.00	-	-	-	41.39	-	-	-	-	-
April,	13.09	4.01	1.72	1:4.48	3.00	3.00	-	3.00	-	15.00	-	-	-	-	-	-	-	15.00
May,	13.00	3.92	1.77	1:4.80	3.00	3.00	-	3.00	-	15.00	-	-	-	-	-	-	-	15.00
June,	13.43	4.28	2.09	1:3.78 1:3.70	3.00 3.00	3.00 3.00	- -	3.00 3.00	- -	5.00 5.00	- -	- -	- -	16.22 -	- 27.50	- -	- -	- -
July,	12.80	3.73	1.82	1:3.76	3.00	3.00	-	3.00	-	5.00	-	-	-	-	-	37.71	-	-
August,	12.30	3.50	2.08	1:5.00	3.00	3.00	-	3.00	-	5.00	50.00	-	-	-	-	-	-	-
September,	12.55	3.66	1.88	1:5.70 1:4.60	3.00 3.00	3.00 3.00	- -	3.00 3.00	- -	5.00 5.00	70.00 30.00	- -	- -	- -	- -	- -	- 20.00	- -
October,	13.17	3.77	1.85	1:5.22	3.00	3.00	-	3.00	-	-	30.00	-	-	-	-	-	20.00	-
Averages,	13.44	4.42	1.82	1:4.60														

3. Value of Cream at Creamery Basis of Valuation.

	Total Cost of Feed consumed.	Total Value of Fertilizing Constituents of Food consumed.	Value of Fertilizing Constituents lost in Cream.	Net Cost of Feed for Production of Cream.	Value of Cream produced.
1891.					
January,	$42 88	$22 85	$0 60	$20 63	$35 23
February,	40 03	24 02	0 61	16 62	35 49
March,	31 38	16 71	0 69	15 36	42 44
April,	35 25	17 52	0 63	18 36	37 36
May,	47 34	22 98	0 74	25 10	40 82
June,	39 32	18 71	0 68	21 29	32 40
July,	40 50	20 20	0 66	20 96	32 26
August,	48 47	20 17	0 68	28 98	36 26
September,	36 88	16 16	0 68	21 40	41 84
October,	41 39	16 62	0 63	25 40	39 48
November,	46 47	17 83	0 52	29 16	32 12
December,	28 75	18 25	0 51	9 93	31 60
Averages,	$39 89	$19 33	$0 64	$21 10	$36 44
1892.					
January,	$31 07	$17 51	$0 55	$14 11	$34 64
February,	34 38	18 36	0 62	16 64	38 95
March,	38 50	20 95	0 76	18 31	45 04
April,	38 47	21 04	0 65	18 08	36 59
May,	35 23	20 13	0 67	15 77	31 65
June,	31 28	19 44	0 57	12 41	27 50
July,	36 11	22 80	0 58	13 89	28 69
August,	39 94	23 95	0 56	16 57	32 22
September,	38 95	22 93	0 55	16 57	33 72
October,	40 12	22 14	0 57	18 55	34 84
Averages,	$36 42	$20 93	$0 61	$16 09	$33 48

4. Cost of Skim-milk at the Selling Price of Three Cents per Quart for Whole Milk.

	Quarts of Milk produced.	Spaces of Cream.	Quarts of Cream (One Quart equals 3.4 Spaces).	Quarts of Skim-milk.	Value of Cream per Space (Cents).	Value of Cream per Quart of Milk (Cents).	Total Value of Cream.	Cost of Skim-milk per Quart (Whole Milk at Three Cents per Quart).	Total Cost of Skim-milk.
1891.								Cents.	
January, .	1,413.5	915.0	269.1	1,144.4	3.85	2.49	$35 23	0.63	$7 18
February, .	1,643.8	934.0	274.7	1,369.1	3.80	2.16	35 49	1.01	13 82
March, . .	1,700.2	1,048.0	308.2	1,392.0	4.05	2.50	42 44	0.62	8 57
April, . .	1,468.1	958.0	281.8	1,186.3	3.90	2.54	37 36	0.56	6 68
May, . .	1,889.7	1,134.0	333.2	1,556.5	3.60	2.16	40 82	1.02	15 87
June, . .	1,841.3	1,045.0	307.4	1,533.9	3.10	1.76	32 40	1.49	22 84
July, . .	1,791.2	1,008.0	296.5	1,494.7	3.20	1.80	32 26	1.44	21 48
August, . .	1,924.0	1,036.0	304 7	1,619.3	3.50	1.88	36 26	1.33	21 46
September, .	1,826.9	1,046.0	307.8	1,519.1	4.00	2.29	41 84	0.85	12 97
October, . .	1,659.9	963.0	283.2	1,376.7	4.10	2.38	39 48	0.75	10 32
November, .	1,424.0	803.0	236.2	1,187.8	4.00	2.24	32 12	0.90	10 60
December, .	1,344.0	790.0	232 4	1,111.6	4.00	2.36	31 60	0.79	8 72
Averages, .	1,660.4	973.3	286.3	1,374.3	3.76	2.21	$36 44	0.95	$13 37
1892.									
January, .	1,460.3	845.0	248.5	1,211.8	4.10	2.38	$34 64	0.75	$9 16
February, .	1,612.4	950.0	279.4	1,333.0	4.10	2.42	38 95	0.71	9 42
March, . .	1,818.0	1,155.0	340.0	1,478.0	3.90	2.45	45 04	0.65	9 50
April, . .	1,704.4	989.0	290.9	1,413.5	3.70	2.14	36 59	1.03	14 54
May, . .	1,806.7	1,021.0	300.0	1,506.7	3.10	1.73	31 65	1.50	22 55
June, . .	1,818.5	873.0	256.8	1,561.7	3.15	1.51	27 50	1.73	27 05
July, . .	1,602.8	883.0	260.0	1,342.8	3.25	1.78	28 69	1.44	19 40
August, . .	1,765.8	848.0	249.4	1,516.4	3.80	1.80	32 22	1.36	20 76
September, .	1,581.4	843.0	248.0	1,333.4	4.00	2.12	33 72	1.03	13 71
October, . .	1,614.7	871.0	256.2	1,358.5	4.00	2.16	34 84	1.00	13 61
Averages, .	1,678.5	927.8	272.9	1,405.6	3.71	2.04	$34 38	1.12	$15 97

5. Fertilizing Constituents of Cream.

[Average analysis.]

	Per Cent.
Moisture at 100° C.,	75.22
Nitrogen (15 cents per pound),	0.54
Potassium oxide (4½ cents per pound),	0.123
Phosphoric acid (5½ cents per pound),	0.168

6. *Conclusions.*

1. The nutritive ratio of the feed varied in 1891 from 1 : 4.17 to 1 : 6.74, with an average of 1 : 5.28; in 1892, from 1 : 3.70 to 1 : 5.70, with an average of 1 : 4.60.

2. The percentage of fat in the milk varied in 1891 from 4.15 to 5.21, with an average of 4.70; in 1892, from 3.50 to 4.55, with an average of 4.42.

3. The percentage of total solids varied in 1891 from 13.41 to 14.99, with an average of 14.24; in 1892, from 12.30 to 13.75, with an average of 13.44.

4. The relation of fat to solids not fat in 1891 was 1 : 2.02, while in 1892 it was 1 : 2.04, proving that the lesser yield of fat in 1892 was not due to the influence of the food but rather to the general inferior character of the cows kept.

5. The total cost of feed for one quart of cream amounted in 1891 to 13.93 cents, and in 1892 to 13.35 cents.

6. The net cost of feed for one quart of cream amounted in 1891 to 7.37 cents, and in 1892 to 5.90 cents.

7. The value received for one space of cream varied in 1891 from 3.1 to 4.1 cents, with an average of 3.75 cents; in 1892, from 3.1 to 4.1 cents, with an average of 3.69 cents; which amounted per quart (average) in 1891 to 12.73 cents, and in 1892 to 12.27 cents.

8. The number of quarts of milk required to produce one space of cream in 1891 was 1.73, and in 1892 1.82; or 5.88 quarts of whole milk to produce one quart of cream in 1891, and 6.18 quarts of whole milk to produce one quart of cream in 1892.

9. The net cost of feed per quart of cream averaged in 1891 7.37 cents, and in 1892 5.90 cents. Received per quart of cream in 1891 12.73 cents, and in 1892 12.27 cents, thereby securing a profit of 5.36 cents per quart in 1891, and 6.37 cents in 1892.

For further details concerning results in preceding years, see eighth annual report, pages 54 to 65, and ninth annual report, pages 76 to 82.

Our average statements for the current year apply in each case to only ten months, due to the fact that the financial settlement is made with our local creamery two months after the cream is furnished.

7. *Analyses of Cream.*

Date of Sampling.	Analysis of Cream. Solids.	Fat.	Solids not Fat.	Average Daily Fodder Rations.
1892.				
Jan. 5, .	28.37	20.29	7.08	3 pounds wheat bran, 3 pounds maize feed, 3 pounds cotton-seed meal, 12.06 pounds dent corn stover.
Jan. 12, .	25.13	16.29	8.84	
Jan. 19, .	24.93	12.95	7.98	3 pounds wheat bran, 3 pounds maize feed, 3 pounds cotton-seed meal, 5 pounds hay, 32 pounds dent corn ensilage.
Jan. 26, .	25.89	15.94	9.95	
Feb. 2, .	27.29	19.21	8.08	
Feb. 16, .	25.62	17.21	8.41	
Feb. 23, .	24.01	15.71	8.30	
March 1, .	26.06	17.26	8.80	3 pounds wheat bran, 3 pounds maize feed, 3 pounds cotton-seed meal, 5 pounds hay, 41.39 pounds sweet corn ensilage.
March 8, .	27.92	20.04	7.88	
March 22, .	25.19	16.13	9.06	
April 19, .	25.18	17.15	8.03	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton-seed meal, 5 pounds rowen, 15 pounds sugar beets.
May 3, .	26.20	19.01	7.19	
June 7, .	25.61	18.80	6.81	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton-seed meal, 5 pounds rowen, 16.22 pounds green rye.
July 19, .	23.40	16.24	7.16	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton-seed meal, 5 pounds rowen, 37.71 pounds vetch and oats.
Aug. 16, .	23.76	17.91	5.85	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton-seed meal, 5 pounds rowen, 60.8 pounds green fodder.
Aug. 23, .	21.35	14.06	7.29	
Aug. 30, .	23.30	16.75	6.55	
Sept. 6, .	22.90	15.88	8.02	
Oct. 18, .	25.63	16.00	9.63	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton seed meal, 15 pounds hay.
Dec. 3, .	25.28	16.90	8.38	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton-seed meal, 15 pounds hay, 15 pounds sugar beets.
Dec. 23, .	25.55	17.00	8.55	3 pounds wheat bran, 3 pounds gluten feed, 3 pounds cotton-seed meal, 15.96 pounds corn stover.

8. Average Milk Analyses for Previous Years.

Year.	Number of Cows.	Total Solids.	Fat.	Solids not Fat.	Relation of Fat to Solids not Fat.
1884, ...	4	13.01	3.71	9.30	1:2.51
1885, ...	2	13.33	4.02	9.31	1:2.33
1886, ...	2	12.91	3.97	8.94	1:2.25
1887, ...	8	12.73	3.83	8.90	1:2.32
1888, ...	6	13.27	3.68	9.59	1:2.61
1889, ...	10	13.91	4.31	9.60	1:2.23
1890, ...	7	14.01	4.64	9.37	1:2.02
1891, ...	14	14.24	4.70	9.31	1:2.02
1892, ...	10	13.42	4.42	9.00	1:2.04

The methods for butter and milk analyses can be found in the ninth annual report, pages 84 to 86.

4. Analyses of Milk of Different Breeds of Cows by Babcock Mode (made by an Assistant of the Station at the Request of the Owner of the Cows at their Farms). 1892.

Guernsey.

Number.	Age (Years).	Last Calf dropped.	Pounds of Milk given.			Per Cent. of Butter Fat in Milk.		Pounds of Butter Fat in Day's Milk.	Previous Records.	Daily Ration for Week preceding Test.	Date of Testing (1892).
			P.M.	A.M.	Total.	P.M.	A.M.				
1	7	Aug. 25, 1891,	8.50	7.00	15.50	4.7	5.4	0.78	None kept, ...	Good pasturage, with 2 quarts of meal, 1 quart of oats, and 4 quarts of bran in addition.	June 13, P.M.; 14, A.M.
2	8	March 23, 1891,	6.00	6.00	12.00	4.0	4.5	0.51	" "		" "
3	9	Sept. 23, 1891,	11.50	8.50	20.00	5.6	5.2	1.09	" "		" "
4	6	Aug. 22, 1891,	4.75	4.00	8.75	6.2	7.1	0.59	" "		" "
5	7	March 21, 1890,	10.25	7.75	18.00	5.6	5.4	0.99	" "		" "
6	7	May 25, 1891,	8.50	6.50	15.00	5.2	5.7	0.81	" "		" "
7	5	May 14, 1892,	14.00	14.50	28.50	4.6	4.9	1.35	" "		" "
8	6	Sept. – 1891,*	5.50	3.75	9.25	6.8	7.0	0 64	" "		" "
9	7	Feb. 21, 1892,	12.50	9.50	22.00	4.4	5.3	1.05	" "		" "
10	9	June 21, 1891,	10.00	8.50	18.50	5.0	5.6	0.98	" "		" "
11	6	May 16, 1890,	8.25	6.00	14.25	5.7	5.4	0.79	" "		" "
12	6	Nov. – 1890,*	7.50	7.00	14.50	6.6	6.9	0.98	" "		" "
13	6	July 25, 1891,	6.50	5.50	12.00	7.0	6.4	0.81	" "		" "
14	6	Aug. 20, 1891,	10.25	8.00	18.25	5.3	6.0	1.02	" "		" "
15	3	Oct. 29, 1891,	11.00	8.25	19.25	5.2	6.8	1.13	" "		" "
16	4	May 20, 1892,	15.00	13.00	28.00	3.7	5.3	1.24	" "		" "
17	–	May – 1892,	11.25	–	–	3.9	3.6	–	" "	Good pasturage, ...	June 9, P.M.; 10, P.M.
18	–	May – 1892,	16.25	–	–	4.2	4.3	–	" "	" "	" "
19	–	Spring, 1891,	4.25	–	–	5.0	6.6	–	" "	" "	" "
20	–	Feb. – 1892,	7.75	–	–	4.8	4.2	–	" "	" "	" "
21	–	April 25, 1892,	14.75	15.00	29.75	5.7	5.0	1.59	" "	" "	June 0, P.M.; 10, A.M.

* Abortion at seven months.

Analyses of Milk, etc. — *Continued.*

Guernsey.

Number.	Age (Years).	Last Calf dropped.	Pounds of Milk given. P.M.	Pounds of Milk given. A.M.	Pounds of Milk given. Total.	Per Cent. of Butter Fat in Milk. P.M.	Per Cent. of Butter Fat in Milk. A.M.	Pounds of Butter Fat in Day's Milk.	Previous Records.	Previous Records. Pounds.	Daily Ration for Week preceding Test.	Date of Testing (1892).
22	-	Oct. - 1891,	11.25	11.00	22.25	4.7	5.9	1.28	None kept,	.	Good pasturage, with 3 quarts of a mixture of equal parts of oats and shorts and on an average 3 quarts of corn meal (some receiving 2 quarts, others 4).	June 9, P.M.; 10, A.M.
23	-	Feb. - 1892,	8.50	8.50	17.00	5.1	7.0	1.03	" "	.		" "
24	-	June 17, 1891,	4.25	3.50	7.75	9.2	6.2	0.61	" "	.		" "
25	-	Feb. - 1892,	10.75	10.25	21.00	5.5	4.9	1.09	" "	.		" "
26	-	April 21, 1892,	11.25	7.25	18.50	5.2	4.5	0.91	" "	.		" "
27*	-	April 19, 1892,	15.25	15.50	30.75	3.2	4.6	1.21	" "	.		" "
28	-	Nov. - 1891,	11.75	11.50	23.25	4.0	4.5	0.99	" "	.		" "
29	-	Spring, 1891,	6.00	5.50	11.50	3.9	4.6	0.74	" "	.		" "
30	-	April 30, 1892,	12.50	11.50	24.00	4.0	4.7	1.04	" "	.		" "
31	-	Feb. 12, 1892,	15.06	15.13	30.19	4.65	4.8	1.43	Feb. 21 — June 4,	2,706	Good pasturage, with hay night and morning, and 2½ quarts corn meal and 3 quarts of shorts; No. 31 received 3 quarts of corn meal and 4 quarts of shorts.	June 3, P.M.; 4, A.M.
32	-	Dec. 15, 1891,	11.00	10.25	21.25	5.1	6.1	1.20	Dec. 20 — June 4,	3,791		" "
33	-	Jan. 28, 1892,	11.38	10.50	21.88	4.8	5.1	1.08	Feb. 7 — June 4,	2,619		" "
34	-	Nov. 15, 1891,	12.13	10.75	22.88	5.1	5.9	1.25	Dec. 6 — June 4,	3,625		" "
35	-	Nov. 25, 1891,	7.75	7.06	14.81	6.3	6.6	0.95	Dec. 6 — June 4,	2,792		" "
36	-	Dec. 29, 1891,	14.44	12.31	26.75	5.0	4.8	1.31	Jan. 3 — June 4,	4,184		" "
37	2½	Feb. 13, 1892,	11.50	10.50	22.00	4.2	4.0	0.90	Feb. 15 — May 31,	2,348.25	Good pasturage, and green rye once a day; the old cows received 4 quarts of corn meal and 4 quarts of shorts; the young cows 2 quarts of corn meal and 4 quarts of shorts.	June 10, P.M.; 11, A.M.
38	9	Feb. 15, 1892,	11.00	11.50	22.50	4.9	5.5	1.17	Feb. 17 — May 31,	2,615.75		" "
39	10	April - 1891,	11.25	11.00	22.25	4.0	4.4	0.93	May - - -	716.50		" "
40	2	Feb. 15, 1892,	8.00	8.00	16.00	4.9	5.1	0.80	Feb. 17 — May 31,	1,647		" "
41	6	Jan. 5, 1892,	11.00	12.00	23.00	4.1	5.2	1.08	Jan. 7 — May 31,	3,561.75		" "
42	2	Feb. 1, 1892,	8.75	8.50	17.25	4.1	4.1	0.71	Mar. 1 — May 31,	1,493		" "
43	9	Jan. 21, 1892,	9.00	9.00	18.00	5.4	4.9	0.93	Jan. 23 — May 31,	2,199	Good pasturage, and green rye once a day; the old cows received 4 quarts of corn meal and 4 quarts of shorts; the young cows 2 quarts of corn meal and 4 quarts of shorts.	" "
44	3	Oct. 2, 1891,	8.25	8.25	16.50	4.1	3.8	0.65	Dec. 1 — May 31,	3,204.25		" "
45	6	Jan. 21, 1892,	13.25	12.00	25.25	3.9	4.2	1.02	Jan. 23 — May 31,	3,667		" "
46	10	Feb. 6, 1892,	9.00	8.75	17.75	4.0	4.9	0.79	Feb. 8 — May 31,	2,418.25		" "
47	3	Dec. 14, 1891,	9.00	8.50	17.50	4.1	4.1	0.72	Dec. 16 — May 31,	3,367.50		" "
48	2½	Dec. 2, 1891,	10.50	10.50	21.00	5.2	4.1	0.98	Dec. 4 — May 31,	3,691.50		" "
49	3	Sept. - 1891,	8.50	8.50	17.00	3.8	3.8	0.65	Dec. 1 — May 31,	2,941.75		" "
50	6	Sept. 29, 1891,	11.25	11.00	22.25	5.0	4.6	1.07	Dec. 1 — May 31,	4,008.75		" "
51	6	Nov. 16, 1891,	15.50	16.50	32.00	4.0	4.2	1.31	Dec. 1 — May 31,	5,554.75		" "
52	2	Feb. - 1892,	6.75	7.00	13.75	4.0	5.4	0.65	Mar. 1 — May 31,	1,347		" "
53	3	Aug. 30, 1892,	10.00	10.00	20.00	4.2	3.9	0.82	Dec. 1 — May 31,	3,348.50		" "

54	13	Jan. 4, 1892,	13.75	10.00	23.75	5.2	6.4	1.36	None kept,	Good pasturage,	June 29, A.M. and P.M.
55	12	Jan. 17, 1892,	7.75	6.25	14.00	3.6	4.0	0.53	" "	" "	" "
56	9	May 8, 1892,	15.00	9.00	24.00	4.0	4.85	1.04	" "	" "	" "
57	9	May 27, 1892,	18.50	16.00	34.50	4.6	5.15	1.68	" "	" "	" "
58	5	April 6, 1891,	9.00	7.00	16.00	4.45	4.3	0.70	" "	" "	" "
59	4	Feb. 13, 1891,	7.25	7.00	14.25	5.1	6.4	0.81	" "	" "	" "
60	4	June 5, 1891,	9.00	7.25	16.25	5.0	5.5	0.85	" "	" "	" "
61	4	April 2, 1891,	8.50	8.00	16.50	4.5	5.2	0.80	" "	" "	" "
62	3	June 18, 1892,	13.00	11.00	24.00	4.8	6.2	1.31	" "	" "	" "
63	5	March 3, 1891,	4.50	4.75	9.25	4.9	4.8	0.45	" "	Good pasturage, and No. 70 received 2 quarts of corn meal and 2 quarts of wheat bran in addition.	June 15, P.M.; 16, A.M.
64	5	Feb. 25, 1892,	9.50	8.75	18.25	3.9	4.4	0.76	" "		" "
65	4	April 10, 1892,	9.88	7.62	17.50	4.2	4.0	0.72	" "		" "
66	3	April - 1891,	6.50	5.00	11.50	4.4	4.2	0.50	" "		" "
67	18	June 10, 1891,	6.00	5.00	11.00	3.8	4.4	0.45	" "		" "
68*	5	April 10, 1892,	6.88	7.00	13.88	3.5	2.8	0.44	" "		" "
69	3	May 1, 1892,	9.25	7.25	16.50	4.8	4.7	0.68	" "		" "
70	6	May 9, 1892,	16.50	12.75	29.25	4.0	3.1	1.06	" "		" "
71	3	July 16, 1892,	10.00	12.00	22.00	3.75	3.50	0.80	" "	Pasturage, with about 20 pounds of green corn fodder and 4 quarts of a mixture consisting of 3 weight parts of corn meal and 2 weight parts of wheat bran in addition.	July 29, P.M.; 30, A.M.
72	3	Sept. 12, 1891,	6.00	7.00	13.00	5.00	5.00	0.65	" "		" "
73	3	Oct. - 1891,	3.50	3.00	6.50	5.10	5.30	0.34	" "		" "
74	4	July - 1891,	8.00	7.00	15.00	5.75	5.00	0.81	" "		" "
75	3	Dec. 21, 1891,	7.00	7.00	14.00	4.80	5.00	0.68	" "		" "
76	4	July 5, 1892,†	7.00	8.25	15.25	5.10	4.80	0.75	" "		" "
77	3	Jan. 16, 1892,	8.00	8.00	16.00	4.50	4.40	0.71	" "		" "
78	4½	Oct. 11, 1891,	6.00	6.50	12.50	4.40	3.85	0.51	" "		" "
79	10	March 24, 1892,	12.00	10.00	22.00	4.30	4.20	0.93	" "		" "
80	7	Feb. 8, 1892,	12.25	11.00	23.25	4.60	3.60	0.96	" "		" "
81	4	July 24, 1892,	12.00	10.50	22.50	2.00	3.60	0.72	" "		" "
82	5½	Dec. 10, 1891,	8.00	7.00	15.00	4.80	3.40	0.62	" "		" "
83	6	Oct. 10, 1891,	4.00	4.00	8.00	4.90	4.65	0.38	" "		" "
									Pounds.		
84	3	June 28, 1892,	10.50	10.75	21.25	5.30	5.80	1.18	June 28 — Aug. 1, 409.25	Pasturage, with 6 pounds of a mixture consisting of equal weight parts of corn meal, wheat bran, new-process linseed meal and cotton-seed meal; No. 18 received 12 pounds of the grain mixture.	July 15, P.M.; 16, A.M.
85	3½	Aug. 18, 1891,	10.50	9.50	20.00	5.30	5.20	1.05	Aug. 18, '91 — Aug. 1, 6,438.50		" "
86	5¼	July 6, 1892,	12.75	14.00	26.75	5.00	4.95	1.33	July 6 — Aug. 1, 215		" "
87	4	March 26, 1891,	6.00	7.00	13.00	4.60	6.20	0.71	Mar. 26, '91 — Aug. 1, 7,150		" "
88	6	May 18, 1892,	18.94‡	17.50	36.44	3.90	3.50	1.35	May 18 — Aug. 1, 2,704		July 16, A.M. and P.M.
89	6	May 9, 1892,	9.14	7.52	16.66	4.80	4.60	0.78	- - -	- - -	- -
90	5	March 3, 1891,	2.15	2.15	4.30	7.10	6.80	0.30	- - -	- - -	- -
91	5	Feb. 25, 1892,	3.22	2.69	5.91	5.20	5.20	0.31	- - -	- - -	- -
92	4	April 10, 1892,	8.06	4.84	12.90	6.30	5.70	0.78	- - -	- - -	- -
93	3	May 1, 1892,	4.84	4.30	9.14	4.80	5.20	0.46	- - -	- - -	- -
94	3	April - 1891,	2.69	2.15	4.84	5.50	6.20	0.28	- - -	- - -	- -

* In heat at time of test. † Carried calf only seven months. ‡ Milked three times a day. This is the sum of the noon and evening milking (8.50 and 13.00 pounds); tested at noon.

Analyses of Milk, etc. — *Continued.*

Holstein.

Number.	Age (Years).	Last Calf dropped.	Pounds of Milk given. P.M.	Pounds of Milk given. A.M.	Pounds of Milk given. Total.	Per Cent. of Butter Fat in Milk. P.M.	Per Cent. of Butter Fat in Milk. A.M.	Pounds of Butter Fat in Day's Milk.	Previous Records (Milk). Pounds.	Daily Ration for Week preceding Test.	Date of Testing (1892).
1	2½	April 28, 1892,	10.00	10.13	20.13	3.80	3.50	0.73	April 28 — Aug. 1, 1,977	Pasturage, with 6 pounds of a mixture consisting of equal weight parts of corn meal, wheat bran, new-process linseed meal and cotton-seed meal.	July 15, P.M.; 16, A.M.
2	3	Jan. 13, 1892,	9.12	8.88	18.00	2.90	2.50	0.49	Jan. 13 — Aug. 1, 4,849		" "
3	3	Jan. 10, 1892,	9.00	8.88	17.88	3.20	1.80	0.45	Jan. 10 — Aug. 1, 4,520		" "
4	3	Nov. 28, 1891,	8.00	8.88	16.88	3.15	2.80	0.50	Nov. 28, '91 — Aug. 1, 4,442		" "
5	6	Feb. 20, 1892,	16.25	16.38	32.63	4.40	3.50	1.29	Feb. 20 — Aug. 1, 7,274		" "
6	5	Dec. 20, 1891,	14.62	15.38	30.00	2.60	4.40	1.06	Dec. 20, '91 — Aug. 1, 8,123		" "
7	5	Jan. 6, 1892,	19.37	19.38	38.75	2.50	2.10	0.89	Jan. 6 — Aug. 1, 9,177		" "
8	2	April 27, 1892,	10.75	11.25	22.00	3.00	1.80	0.53	April 27 — Aug. 1, 1,819		" "
9	3	June 27, 1891,	6.00	6.63	12.63	3.10	2.80	0.37	June 27, '91 — Aug. 1, 7,379		" "
10	3	June 14, 1891,	7.12	7.38	14.50	3.40	4.00	0.54	June 14, '91 — Aug. 1, 7,394		" "
11	3	Feb. 10, 1892,	9.87	10.13	19.00	2.80	1.85	0.46	- - -		" "
12	3	June 1, 1892,	18.50	21.00	39.50	2.00	2.40	0.87	Feb. 10 — Aug. 1, 1,928		" "
13	3	July 2, 1892,	-	18.75	-	-	3.00	-	July 2 — Aug. 1, 409	Pasturage, with 12 pounds of the above grain mixture.	July 16, A.M. and P.M.
14	7	May 11, 1891,	-	2.00	-	-	2.70	-	May 11, '91 — Aug. 1, 13,688		" "

Analyses of Milk, etc. — *Concluded.*

Holstein.

Number.	Age (Years).	Last Calf dropped.	Pounds of Milk given. A.M.	M.	P.M.	Total.	Per Cent. of Butter Fat in Milk. A.M.	P.M.	Pounds of Butter Fat in Day's Milk.	Previous Records (Milk). Pounds.	Daily Rations for Week preceding Test.	Date of Testing (1892).
15	7	April 27, 1892,	23.75	19.44	15.31	58.50	1.80	3.60	1.68	April 27 — Aug. 1, 4,697	Pasturage, with 12 pounds of a mixture consisting of equal weight parts of corn meal, wheat bran, new-process linseed meal and cotton-seed meal.	July 16, A.M. and P.M.
16	7	June 25, 1892,	19.56	14.94	15.06	49.56	2.00	3.60	1.46	June 25 — Aug. 1, 1,495		" "
17	5	April 13, 1892,	19.25	15.12	16.63	51.00	2.00	3.40	1.46	April 13 — Aug. 1, 5,805		" "
18	7	June 19, 1892,	24.00	16.00	20.00	60.00	2.20	3.90	1.93	June 19 — Aug. 1, 2,235		" "
19	6½	June 1, 1892,	25.00	16.00	23.00	64.00	3.80	2.10	1.77	June 1 — Aug. 1, 3,075		" "
20	9	April 27, 1892,	18.00	12.75	14.50	45.25	2.70	3.40	1.41	April 27 — Aug. 1, 4,082		" "
21	4	June 1, 1892,	18.12	14.69	14.44	47.25	3.00	4.10	1.74	June 1 — Aug. 1, 976		" "

5. Discussion on Fodder Articles and Fodder Supplies.

[Home-raised Fodder Articles. — Commercial Feed Stuffs. — 1892.]

The fodder articles used in the preparation and compounding of the daily diet of all kinds and conditions of farm live stock are, as a rule, obtained from two distinctly different sources. They are either raised upon the farm and are used usually without any material change in composition, or they are bought in the general market, and are in that case usually the by-products or waste materials of various other branches of industry, as oil works, flour mills, starch works, glucose factories, breweries, etc.

The home-raised fodder crops furnish in the majority of cases the coarse fodder constituent of the daily diet, while the waste or by-products of other industries furnish the fine or grain feed portion of the daily fodder rations. A rational and economical system of stock feeding has assigned to each of these two groups of feed stuffs its proper position in the daily diet of all kinds of farm live stock, with special reference to their general character, adaptation and composition, as well as to good economy and particular efficiency.

A liberal and economical supply of *both classes of fodder articles* is to-day recognized as an indispensable requirement of an economical system of stock feeding. To meet our present market condition of the products of the dairy and of the meat supply with any reasonable prospect of a satisfactory compensation for capital invested and labor spent, calls, if possible, for cheaper and more efficient fodder rations than in the majority of instances are in current use.

The importance of a serious and careful consideration of the present condition of our fodder supplies, from both above-stated sources, forces itself from day to day more, not only upon the attention of every farmer, but of all parties interested in the support of our animal industry.

The controlling influence of the temporary local market cost of some of our most prominent current fodder articles on the cost of the production of milk and meat, has been for years pointed out in our bulletins and annual reports, in con-

nection with a description of numerous feeding experiments with milch cows, growing steers, lambs and pigs. An examination of our previous statements concerning the influence of the particular kind of feed stuffs used in the composition of the daily fodder rations on the *market cost*, as well as on the *net cost*, of the feed consumed in the operation, cannot fail to show some striking instances, proving in a marked degree the previously pointed-out circumstance.

As the fodder for our farm live stock comes from two different sources, of equal importance as far as variety, economy and efficiency are concerned, it seems but proper to consider our chances for the improvement of our fodder supply under two separate headings, namely : —

1. Home-raised fodder articles.
2. Commercial feed stuffs.

1. *Home-raised Fodder Articles.*

On various previous occasions, and in particular in Bulletin No. 36, an attempt was made to show that an increase in the production of cultivated annual fodder crops, aside from Indian corn or maize, will tend to increase in an economical way the general productiveness of our farm lands in case of a mixed system of farm industry. The introduction of a greater variety of reputed fodder crops, in particular of the clover family (*Leguminosæ*), it was stated, would prove with us, as it had proved elsewhere, an efficient means to increase not only in an economical way the general productiveness of our farm lands, but tend to *cheapen the cost of feed* for all kinds of farm live stock. A short abstract from the above-stated bulletin may suffice on this occasion to show the standpoint assumed in the matter : —

A careful inquiry into the history of agriculture has shown that the original productiveness of farm lands in all civilized countries, even in the most favored localities, has suffered in the course of time a gradual decline. This general decline in the fertility of the soil under cultivation has been ascribed, with much propriety in the majority of instances, mainly to two causes, namely : —

A gradual but serious reduction in the area occupied *by forage crops*, natural *pastures* and *meadows;* and a marked decline in the

annual yield of fodder upon large tracts of lands but ill suited for a permanent cultivation of grasses, — the main reliance of fodder production at the time.

A serious falling off in the annual yield of pastures and meadows was followed usually by a gradual reduction in farm live stock, which in turn caused a falling off in the principal home resource of manurial matter.

This chapter in the history of farm management has repeated itself in most countries. The unsatisfactory results of that system of farming finds still an abundant illustration in the present exhausted condition of a comparatively large area of farm lands in New England.

Careful investigations carried on during the past fifty years for the particular benefit of agriculture have not only been instrumental in recognizing and pointing out the principal causes of an almost universal periodical decline of the original fertility of farm lands, but have also materially assisted by field experiments and otherwise in introducing efficient remedies to arrest the noted decline in the annual yield of our most prominent farm crops.

As a scanty supply of manurial matter, due to a serious falling off of one of the principal fodder crops, grasses, was found to be one of the chief causes of less remunerative crops, and thus indirectly has proved to be the main cause of an increase in the cost of the products of the animal industry of the farm, milk and meat, it is but natural that the remedies devised should include, as one of the foremost recommendations, *a more liberal production of nutritious fodder crops.*

The soundness of this advice is to-day fully demonstrated in the most successful agricultural regions of the world. An intensive system of cultivation has replaced in those localities the extensive one of preceding periods; although the area under cultivation for the production of general farm crops has been reduced, the total value of the products of the farm has increased materially in consequence of a more liberal cultivation of reputed fodder crops. The change has been gradual and the results are highly satisfactory.

Viewing *our own present condition*, we notice that well-paying grass land, good natural meadows and rich and extensive pastures are rather an exception than the rule. The benefits derived from indifferently yielding natural pastures are often more apparent than real; the low cost of the production of the fodder is frequently in a large degree set off by a mere chance distribution of the manure produced.

A continued cultivation of but few crops upon the same land, without a liberal, rational system of manuring, has caused in many

instances a one-sided exhaustion of the land under cultivation. This circumstance has frequently been brought about in a marked degree by a close rotation of mixed grasses (meadow growth) and of our next main reliance for fodder, the corn (maize). Both crops require potash and phosphoric acid in similar proportion (4 potassium oxide to 1 phosphoric acid), and both require an exceptional amount of the former.

There is good reason to assume that the low state of productiveness of many of our farms, so often complained of, is largely due to the fact that crops have been raised in succession for years, which, like those mentioned, have consumed one or the other essential article of plant food in an exceptionally large proportion, and thereby have gradually unfitted the soil for their remunerative reproduction, while a liberal supply of other equally important articles of plant food is left inactive behind.

As the amount of *available plant food* contained in the soil represents largely the working capital of the farmer, it cannot be otherwise but that the practice of allowing a part of it to lie idle must reduce the interest on the investment.

Personal local observation upon the lands assigned for the use of the station has furnished abundant illustration of the above-described condition of farm lands. In one instance it was noticed that a piece of old, worn-out grass land, after being turned under and properly prepared, as far as the mechanical condition of the soil was concerned, produced, *without any previous application of manure*, an exceptionally large crop of horse beans and lupine, — two reputed fodder crops.

A similar observation was made during the past season, when lands which for years had been used for the production of English hay and corn were used for the cultivation of Southern cow-pea, serradella and a mixed crop of oats and vetch, to serve as green fodder for milch cows. The field engaged for the production of these crops was not manured, because it was to be prepared for a special field experiment during the following season. An area of this land which, under favorable circumstances, would not produce more than six tons of green grass at the time of blooming, yielded nine to ten tons of green vetch and oats, ten tons of green Southern cow-pea, and from twelve to thirteen tons of green serradella.

The exceptional exhaustion of our lands in potash has also been shown abundantly by detailed description of experiments with fodder corn in previous annual reports.

Our local results during past years tend to confirm the opinion held by successful agriculturists that dry grass lands which are in an exceptional degree inclined to a spontaneous overgrowing by

an inferior class of fodder plants and weeds, if at all fit for a more thorough system of cultivation, ought to be turned by the plough and subsequently planted with *some hoed crop*, to kill off the foul growth and to improve the physical and chemical condition of the soil. *Such lands prove in many instances ultimately a far better investment when used for the raising of other fodder crops than grasses.*

The less the variety of crops raised in succession upon the same lands, the more one-sided is usually the exhaustion of the soil, and the sooner, as a rule, will be noticed a decrease in their annual yield. The introduction of a greater variety of fodder plants enables us to meet better the differences in local conditions of climate and of soil, as well as the special wants of different branches of farm industry. In choosing plants for that purpose, it seems advisable to select crops which would advantageously supplement our leading fodder crop (aside from the products of pastures and meadows), the fodder corn and corn stover.

Taking this view of the question, the great and valuable family of leguminous plants, as clovers, vetches, lucerne, serradella, peas, beans, lupines, etc., is in a particular degree well qualified for that purpose. They deserve also a decided recommendation in the interest of a wider range for the introduction of economical systems of rotation of crops, under various conditions of soil and different requirements of markets. Most of these fodder plants have an extensive root system, and for this reason largely draw their plant food from the lower portion of the soil. The amount of stubble and roots they leave behind after the crop has been harvested is exceptionally large, and decidedly improves both the physical and chemical condition of the soil. The lands are subsequently better fitted for the production of shallow growing crops, as grains, etc. Large productions of fodder crops assist in the economical raising of general farm crops; although the area devoted to cultivation is reduced, the total yield of the land is usually more satisfactory.

Believing in the soundness of the above-stated views, it has been for years a special task of our work at the station to investigate upon our farm lands the comparative merits, if any, of a variety of fodder plants new to our locality and of a fair reputation elsewhere, as may have been noticed in our annual report. From among those fodder plants which showed a fair degree of adaptation to our soil and climate we have selected for several years past a few for cultivation on a large scale, to increase our fodder supply during the summer and winter season, either as green fodder or in the form of ensilage and hay.

The new crops thus far selected for that purpose are all annual leguminous plants (clover family), as summer vetch, Scotch tares, soja bean, serradella, horse bean and Southern cow-pea. These crops can claim a higher nutritive value than the grasses, and they yield in the majority of cases a larger return per acre. They are readily and with advantage introduced into most local systems of rotation, they tend to increase materially the nitrogen resource of the soil they are raised on in an economical way, besides improving the physical and chemical conditions of the soil in various directions.

One of the principal aims in the cultivation of fodder crops of every description ought to be an increase of their nitrogen containing organic constituents as far as practicable. This result is of special interest in the dairy industry, for milch cows, among full-grown animals, require an exceptionally nutritious diet to do their best.

No class of farm crops shows in a more marked degree the influence of a liberal use of manure. Both the quantity and quality of these crops are materially improved when raised upon lands in a fair state of fertility. Exhausted lands produce invariably an inferior quality of fodder crops of its kind, as far as the amount of their nitrogen-containing organic constituents is concerned. *A liberal production of nutritious annual fodder crops of the right kind improves our chances of supporting more farm live stock, tends to increase our supply of home-made manure, and ultimately becomes the chief reliance of a remunerative mixed farm industry.*

Our trials on a small scale with new fodder crops during the past year include the following : —

Summer vetch,
Soja bean,
Bokhara clover,
Sanfoin,
Horse bean,
Cow-pea,
Yellow trefoil,
Serradella,
Prickly comfrey,
Flat-pea or *Lathyris sylvestris*,
Kidney vetch,
Blue lupine,
Yellow lupine,
White lupine,
Silver-hull buckwheat,
Japanese buckwheat,
Common buckwheat,
Summer rape,
Winter rape,
Artichoke (Jerusalem),
Sugar beet.

Several of the above-enumerated more or less reputed fodder plants have been for some years past successfully cultivated upon the fields of the station, as may have been noticed from previous communications. Some of them have been raised again during the past season on a becoming scale to increase our fodder supply for milch cows, etc., as green fodder during summer and autumn and as ensilage during winter and spring. A summary of our results may be noticed in the following tabular statement. The estimate in regard to meadow growth is based on the results obtained by us on exceptionally good grass land (two tons of first cut and one ton of second cut hay). The annual average yield of meadows for the entire State does not much exceed one ton of hay.

CROP.	Yield per Acre (Tons).	Dry Matter (Per Cent.).	Dry Matter per Acre (Pounds).	Nitrogen in Dry Matter (Per Cent.).	Nitrogen per Acre (Pounds).
Fodder corn (kernels glazing),	18	31.47	11,329	1.02	116
Serradella,	12	17.97	4,313	2.42	104
Vetch and oats,	8.05	17.98	2,894	2.68	78
Soja bean,	11.1	26.80	5,949	1.19	71
Hay,	2	87.72	3,509	1.64	58
Rye,	7	37.89	4,466	0.85	37
Peas and oats,	5	13.68	1,368	2.63	36
Rowen,	1	89.79	1,795	2.00	36
Hungarian (second crop after rye),	2.5	25.69	1,285	1.50	18

Rye, vetch and oats, peas and oats, part of soja bean, of corn and of serradella have been fed as green fodder or as hay, and the remainder of green corn and soja bean, serradella and Hungarian, is on hand in silos as mixed ensilage for winter use.

2. *Commercial Feed Stuffs.*

The name commercial feed stuff or concentrated commercial feed stuffs is usually applied to a class of substances offered for sale in our markets which, in the majority of cases, are the waste or by-products of other branches of industry. Some of these articles, as brans, middlings and oil cakes have been for years quite generally used in the daily diet of all kinds of farm live stock; others, as the gluten meal,

gluten feed, corn germ meal, dried brewers' grain, malt sprouts, etc., are but recently more generally offered for a similar purpose.

Their importance as an additional valuable fodder supply for the support of every branch of animal industry on the farm and elsewhere has become from year to year more conspicuous, on account of a marked increase of the supply of well-known articles, as well as of the introduction of many new kinds. Their consumption is apparently daily increasing, and seems to keep step with the supply.

The special value claimed for commercial feed stuffs as an important source of fodder supply rests in the main on their fitness to supplement advantageously our coarse home-raised fodder crop in the interest of a higher feeding effect and of a better economy. A frequently good mechanical condition, as well as an exceptionally valuable chemical composition, adapt many of them in a high degree for that purpose.

As no single farm crop or any part of them has been found to supply economically and efficiently to any considerable extent the particular wants of food of our various kinds of farm live stock to secure the best possible results, it becomes a matter of first importance from a mere financial stand-point to know how to supplement our current farm crops to meet the wants of each kind of animals under various circumstances in a desirable degree To secure the highest feeding effect of each fodder article raised upon the farm is most desirable in the interest of good economy.

Practical experience in the dairy has thus far abundantly shown that the efficiency of a daily diet does not so much depend on the mere use of more or less of one or the other reputed fodder article as on the presence of suitable fodder articles which contain the *three essential groups of food constituents*, i. e., *organic nitrogenous*, *non-nitrogenous and mineral constituents of plants*, in a desirable form, and in such relative proportions and quantities as have been recognized to be necessary to meet efficiently the food supply of the dairy cow. Similar relations are known to exist in regard to the diet best adapted in case of all kinds of animals. *An economical system of stock feeding has to select among the suitable fodder articles those which furnish the required quality and proportion of the three recognized*

essential food constituents in a digestible form, at the lowest cost.

Actual observations in stock feeding fully confirm the correctness of the above statement, that a judicious selection from among the current commercial feed stuffs, for the purpose of serving in connection with one or more of our home-raised fodder plants as a fodder ingredient of the daily diet, does, as a rule, tend not only to improve their food value, but also lowers in the majority of cases the net cost of the feed consumed. For more details regarding the determination of the intrinsic value of fodder rations I have to refer on the present occasion, for obvious reasons, to preceding annual reports.

The majority of commercial feed stuffs occupy in a rational system of stock feeding a similar position to our home-raised fodder crops, as is commonly conceded to the commercial fertilizer, with reference to the barn-yard manure for the production of farm crops; they serve for the preparation of a complete diet under different conditions and for different purposes. The individual merits of each of them become in the same degree better appreciated, as the principles which govern animal nutrition are *more generally* understood, and *find a due recognition* in our modes of compounding the daily diet for different kinds as well as for different conditions of the same kind of animals. *They are as a class to-day considered indispensable for a remunerative management of every branch of animal industry on the farm and elsewhere.*

Many of the commercial feed stuffs contain, aside from a liberal amount of phosphoric acid and potash, an exceptionally large percentage of nitrogen. This circumstance gives them a special claim, independent of their respective food value for animals. A liberal addition of these feed stuffs to the daily diet of any kind of animal imparts to the manurial refuse resulting from their use a corresponding higher commercial and agricultural value as a valuable source of plant food. A judicious and liberal introduction of a quite numerous class of commercial feed stuffs into the daily fodder supply of the animals kept on the farm is for this reason *deservedly* recommended as a safe and economical

way to increase the home production of plant food in the interest of an increase in the fertility of the farm lands.

As the financial success of a mixed system of farming in particular depends to a considerable degree on the character, the amount and the cost of production of the manurial refuse secured in connection with the special farm industry carried on at the time, it seems to need no further argument to prove that the relation which exists between the temporary *market cost* of the particular feed stuff under consideration and the *market value* of the manurial elements which it contains deserves a serious consideration when devising an efficient and at the same time an economical diet.

The character and commercial value of the manurial refuse obtainable from any kind of feed stuff, under otherwise corresponding conditions, stands in a direct relation to more or less of the different essential fertilizing constituents — phosphoric acid, potash, and in particular nitrogen — it contains. The commercial value of these three important articles of plant food found frequently in prominent commercial feed stuffs equals in many instances more than one-half of the market cost of the particular fodder ingredient in question.

The subsequent tabular statement may serve as an illustration of these relations between market cost and fertilizing value of some current reputed fodder articles: —

NAME OF FEED STUFF.	Market Cost (per Ton)	Manurial Value (per Ton).
Corn meal,	$24 00	$7 31
Gluten meal (Chicago),	28 00	14 72
Chicago maize feed,	25 00	13 25
Buffalo gluten feed,	23 00	12 57
Cotton-seed meal,	28 00	23 52
Linseed meal (old process),	26 00	19 22
Linseed meal (new process),	27 00	20 37
Wheat middlings,	17 00	9 50
Wheat bran,	17 00	13 23
Dried brewers' grain,	23 00	9 96
English hay (first cut of meadows),	15 00	5 92
Rowen (second cut of meadows),	15 00	7 00
Corn fodder,	7 00	4 55
Corn stover,	5 00	3 75
Corn ensilage,	2 50	1 53
Sugar beets,	5 00	1 21
Mangold roots,	4 00	1 01

The above-stated market cost is subject to periodical changes, and the commercial value of their fertilizing constituents varies more or less with the quality of each kind. This feature does not affect materially the force of the point made.

A due appreciation of the previously pointed out favorable features regarding the peculiar character of a numerous class of commercial feed stuffs has caused a steady increase in their consumption on the farm and elsewhere. *The money invested by farmers for securing commercial feed stuffs as an additional food supply for home consumption exceeds to-day many times the amount spent for commercial fertilizers.*

As no single commercial feed stuff can be expected to meet our present demand for these articles, nor can claim to be the most economical one under varying market conditions, and with due appreciation of the varying character of our home-raised fodder supply, it is but proper that every new addition in suitable kinds should receive a deserved attention, and subsequently an actual trial to ascertain its individual merits.

A considerable number of these feed stuffs has already been tried at this station during past years, in connection with our feeding experiments with milch cows, growing steers, lambs and pigs, as may have been noticed in our periodical reports; others are at present on trial. The articles used on those occasions were as a rule bought in the general market. A still larger number of different kinds have been analyzed by us at the request of farmers and dealers in feed stuffs; the samples were usually sent on for that purpose. In regard to the former, there can be no reasonable doubt about their identity; as far as the latter are concerned, the responsibility of furnishing fair representative samples rests in some instances with the parties asking for the analyses.

The results of our analyses of commercial feed stuffs are embodied in the subsequent tabular statement. The record of the analyses is here purposely confined to the extremes noticed, as far as the percentage of *fat* and *nitrogen-containing* organic matter or crude protein are concerned, to engage a special attention in that direction: —

NAME OF FEED STUFF.	Analyses.	Dry Matter (Per Cent.).			Dry Matter contains					
					protein (per cent.).			fat (per cent.).		
		Maximum.	Minimum.		Maximum.	Minimum.		Maximum.	Minimum.	
*Corn meal,	29	89.95	82.96	–	15.57	9.73	–	5.08	3.10	–
*Gluten meal (Chicago),	22	93.50	68.32	–	39.28	25.94	–	12.05	3.92	–
*Gluten feed (Buffalo),	3	93.19	91.03	–	31.05	26.16	–	18.46	11.73	–
Dick gluten flour,	1	–	–	92.93	–	–	33.89	–	–	17.11
Corn germ meal,	1	–	–	90.65	–	–	28.26	–	–	11.82
*Maize feed (Chicago),	3	91.40	90.25	–	29.40	21.33	–	7.90	6.15	–
Dick gluten feed,	1	–	–	91.01	–	–	8.51	–	–	2.26
Corn screenings,	1	–	–	88.98	–	–	8.29	–	–	4.48
Starch feed,	1	–	–	42.96	–	–	22.41	–	–	10.17
Coon gluten meal,	1	–	–	92.13	–	–	25.03	–	–	10.48
Corn germ feed,	1	–	–	92.45	–	–	10.81	–	–	12.17
Hominy meal,	4	91.89	88.68	–	11.88	6.77	–	12.22	4.89	–
*Wheat kernels,	1	–	–	89.42	–	–	13.35	–	–	1.79
*Wheat bran,	35	92.58	86.30	–	20.54	15.67	–	6.08	2.80	–
*Wheat middlings,	6	90.65	87.57	–	19.21	15.13	–	6.46	3.19	–
*Rye bran,	2	91.82	86.30	–	18.98	16.52	–	3.03	2.07	–
*Rye middlings,	1	–	–	87.46	–	–	13.15	–	–	5.61
*Ground barley,	4	89.09	82.59	–	14.93	10.42	–	2.38	1.69	–
*Spent brewers' grain,	4	93.02	88.00	–	33.16	16.08	–	6.29	1.95	–
Malt sprouts,	1	–	–	84.63	–	–	27.17	–	–	3.85
Oat feed,	1	–	–	90.66	–	–	14.06	–	–	8.23
Buckwheat middlings,	1	–	–	88.49	–	–	25.49	–	–	7.53
*Cotton-seed meal,	19	91.31	88.81	–	51.79	36.54	–	14.72	9.47	–
Cotton hulls,	2	89.83	88.55	–	5.36	4.99	–	4.27	2.36	–
*Linseed cake (old process),	7	92.52	88.50	–	39.97	30.98	–	9.87	6.24	–
*Linseed cake (new process),	5	94.94	88.17	–	41.02	35.30	–	4.08	2.17	–

Articles marked * have been bought in the market, or were raised on the land of the station, and there can be no reasonable doubt about fair sampling. The remainder were sent on with name recorded above.

A careful examination of the preceding partial analyses of current commercial feed stuffs cannot fail to show *the existence of most serious variation in the amount of the two most costly food constituents, in case of the same kind.* The differences noticed in that direction affect in many instances, in a marked degree, the food value of the particular article as well as its comparative money value. Some of these variations may be due to differences in the processes at the time employed in the parent industry. *The fact that the majority of this class of feed stuffs are waste or by-products of other industries renders them in an exceptional degree liable to changes in composition. This feature in their production deserves a most careful consideration, from a financial point of view, on the part of the buyer.*

Commercial feed stuffs are usually bought for their high percentage of either nitrogen-containing organic matter or fat, or both. They are used to enrich the daily diet of various kinds of farm live stock in both directions. This course is generally adopted on account of a well-known deficiency of most of our home-raised coarse fodder articles in regard to both food constituents, in particular of nitrogenous matter. Farmers that do not raise a liberal proportion of clover-like fodder plants are in a particular degree in need of concentrated commercial feed stuffs rich in nitrogenous food constituents, to turn the excess of the non-nitrogenous food constituents which most of our current home-raised coarse fodder articles contain to the best possible account.

The liability of pecuniary losses on the part of the buyer, in consequence of exceptional variations in the percentage of nitrogenous organic matter, crude protein or fat, or of both, is quite frequently greatly aggravated by most unexpected serious fluctuations in the market cost of leading feed stuffs.

As we buy in the majority of cases the concentrated commercial feed stuffs on account of their large proportion of nitrogen-containing food constituents, it becomes of special interest to know at what cost a *given quantity of nitrogen-*

containing food constituents can be bought in the form of different feed stuffs equally well adapted under existing circumstances. A change in the *market cost* of one and the same commercial feed stuff affects the cost of the nitrogen-containing food constituent in particular as its supply is more limited than that of the non-nitrogenous food constituents which our home-raised coarse fodder articles contain as a rule in abundance, and which therefore need not to be secured from outside resources for cash.

The subsequent tabular statement assumes a constant cost of digestible non-nitrogenous food constituents, — sugar, starch, fat, etc., — and shows thereby the variations in the cost of digestible nitrogen-containing food constituents, in case of some prominent concentrated commercial feed stuffs in our local market.

The majority of analyses stated are made of fodder articles which have been used either during the past year in connection with some of our feeding experiments, or have been raised upon the grounds of the station. Some articles sent on by outside parties are added, on account of the special interest they may present to others.

Valuation of Fodder Articles on the Following Basis.

[Digestible cellulose and nitrogen-free extract matter, 1 cent per pound; digestible fat, 2½ cents per pound. The value of digestible protein determined the difference of the sum of both and the market cost of the fodder articles. (Calculation is based on dry matter, 2,000 pounds.)]

	Market Cost.	Protein per Pound (Cents).
Corn meal,	$31 00	6.88
Corn meal,	29 00	5.84
Corn meal,	24 00	3.24
Corn meal,	23 00	2.72
Wheat middlings,	20 00	3.13
Spring wheat bran,	19 00	3.04
Winter wheat bran,	21 00	3.93
Chicago maize feed,	23 00	2.34
Dried brewers' grain,	22 00	3.37
Old-process linseed meal,	26 00	2.20
New-process linseed meal,	27 00	2.68
Chicago gluten meal,	28 00	2.46
Cotton-seed meal,	28 00	2.34
English hay,	12 00	1.36
English hay,	15 00	4.12
Rowen,	12 00	1.21
Rowen,	15 00	3.24
Corn stover,*	5 00	–
Corn ensilage,*	2 50	–
Mangold roots,*	3 00	–
Sugar beets,*	5 00	–

* The value of the digestible cellulose, nitrogen-free extract matter and fat, on the above basis, exceeds the market cost.

Prices are apt to rise and to fall without any reference to the agricultural value of the article in question.

Names may remain the same, and in fact do remain in some instances, while the composition of the article suffers serious changes in consequence of changes in the parent industry.

Sales without due responsibility regarding the particular quality of the goods delivered leaves the pecuniary risk involved in the transaction in an objectionable degree on the side of the buyer.

Unaccounted-for variations in the composition of feed stuffs must prove a serious obstacle in the desirable introduction of a rational and economical system of stock feeding.

For these and other reasons previously pointed out it cannot be claimed that the prevailing mode of selling and buying commercial feed stuffs rests on a just and fairly equitable basis.

The trade in commercial feed stuffs is to-day in a similar unsatisfactory condition as was the trade in commercial fertilizers before the introduction of a system of State inspection in regard to those articles.

The generally conceded success of the introduction of a well-regulated system of State inspection in regard to commercial fertilizers seems to suggest the adoption of a similar course with reference to the trade in commercial feed stuffs.

The best interests of both manufacturers and farmers, in fact of every one who keeps live stock for his accommodation, render such changes desirable in the present mode of selling and buying feed stuffs as will impose mutual and equitable responsibility on all parties interested in the transaction. The limited margins for profit in every branch of animal industry carried on at our farms necessitates a careful attention to all the details of the business. The money interests involved are of an exceptional magnitude.

A due consideration of the present condition of our trade in commercial feed stuffs has induced the Board of Control of the Massachusetts State Agricultural Experiment Station to request the writer to present the subject once more to the consideration of all parties interested: and to invite their co-operation in devising suitable means to secure a fair degree of mutual responsibility on the part of all parties interested in the trade and the consumption of commercial feed stuffs.

C. A. GOESSMANN.

November, 1892.

6. Analyses of Fodder Articles made at the Station in 1892.

Green Corn (1891).

[I., Pride of the North; II , Stowell's Evergreen.]

[From station barn.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	71.86	83.91
Dry matter,	28.14	16.09
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	3.78	6.73
" cellulose,	25.67	26.03
" fat,	2.24	3.26
" protein,	7.62	8.09
Non-nitrogenous matter,	60.69	55.89
	100.00	100.00

Corn Stover (1891).

[I., Pride of the North; II., Stowell's Evergreen.]

[From station barn.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	20.10	41.62
Dry matter,	79.90	58.38
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	6.12	9.76
" cellulose,	33.72	37.79
" fat,	2.51	2.44
" protein,	7.75	6.08
Non-nitrogenous matter,	49.90	43.93
	100.00	100.00

Corn Kernels (1891).

[I., Pride of the North; II., Stowell's Evergreen.]

[From station barn.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	13.68	11.98
Dry matter,	86.32	88.02
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	1.29	1.63
" cellulose,	1.69	2.41
" fat,	4.11	9.56
" protein,	10.42	12.57
Non-nitrogenous matter,	82.49	73.83
	100.00	100.00

Corn Cobs (1891).

[I., Pride of the North; II., Stowell's Evergreen.]

[From station barn.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	7.00	5.95
Dry matter,	93.00	94.05
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	1.42	2.53
" cellulose,	37.84	34.19
" fat,	0.35	0.77
" protein,	1.46	1.73
Non-nitrogenous matter,	58.83	58.78
	100.00	100.00

Stowell's Evergreen Sweet Corn (1891).

[From station barn.]

	I.	II.	III.	IV.
Ears (four) : —				
Number of rows,	14	14	16	14
Moisture at 100° C,	11.98	11.98	11.98	11.98
Total weight of ear (grams),	116.3	104.6	111.5	79.3
Weight of kernels (grams),	91.87	77.4	90.9	61.0
Per cent. of total weight,	78.99	73.99	81.52	76.92
Weight of cobs (grams),	24.43	27.2	20.6	18.3
Per cent. of total weight,	21.01	26.01	18.48	23.08

Corn Ensilage (1891).

[I., Pride of the North; II., Stowell's Evergreen.]

[From station barn.]

	Per Cent.	
	I.	II.
Moisture at 100° C,	79.98	84.30
Dry matter,	20.08	15.70
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	4.99	6.32
" cellulose,	27.19	29.32
" fat,	3.29	7.36
" protein,	8.29	7.86
Non-nitrogenous matter,	56.24	49.14
	100.00	100.00
Acidity (as acetic acid),	1.18	1.33

Fertilizing Constituents.

Moisture,	79.98	84.30
Nitrogen,	0.266	0.197
Phosphoric acid,	–	0.087
Potassium oxide,	–	0.406
Valuation per 2,000 pounds,	–	$1 05

Vetch and Oats, green (1891).

[From station barn.]

	Per Cent.
Moisture at 100° C.,	57.96
Dry matter,	42.04
	100.00

Analysis of Dry Matter.

Crude ash,	7.97
" cellulose,	30.77
" fat,	2.58
" protein,	8.83
Non-nitrogenous extract matter,	49.85
	100.00

Notes on Changes in Dry Matter during Growth.

	July 7, 1891.	July 22, 1891.	Aug. 3, 1891.
Moisture at 100° C.,	79.75	64.77	57.96
Dry matter,	20.25	35.23	42.04

Soja Bean, green (1891).

[From station barn.]

	Per Cent.
Moisture at 100° C.,	72.22
Dry matter,	27.78
	100.00

Analysis of Dry Matter.

Crude ash,	6.39
" cellulose,	31.49
" fat,	3.39
" protein,	13.71
Non-nitrogenous extract matter,	45.02
	100.00

Notes on Changes in Dry Matter during Growth.

	Aug. 3, 1891.	Aug. 17, 1891.	Sept. 2, 1891.
Moisture at 100° C.,	80.24	72.22	70.22
Dry matter,	19.76	27.78	29.78

Green Rye (1892).

[From station barn.]

	Per Cent.
Moisture at 100° C.,	62.11
Dry matter,	37.89
	100.00

Analysis of Dry Matter.

Crude ash,	5.27
" cellulose,	21.52
" fat,	2.46
" protein,	5.38
Non-nitrogenous extract matter,	65.37
	100.00

Fertilizing Constituents.

Moisture,	62.11
Nitrogen,	0.327
Phosphoric acid,	0.15
Potassium oxide,	0.734
Valuation per 2,000 pounds,	$1 80

Hungarian Grass, green * *(1892).*

[From station barn.]

	Per Cent.
Moisture at 100° C.,	74.31
Dry matter,	25.69
	100.00

Analysis of Dry Matter.

Crude ash,	8.94
" cellulose,	31.23
" fat,	2.43
" protein,	9.39
Non-nitrogenous extract matter,	48.01
	100.00

Fertilizing Constituents.

Moisture,	74.31
Nitrogen,	0.385
Phosphoric acid,	0.159
Potassium oxide,	0.549
Valuation per 2,000 pounds,	$1 82

* Second crop after rye.

Green Corn Fodder (1892).

[From station barn.]

	Per Cent.
Moisture at 100° C.,	68.53
Dry matter,	31.47
	100.00

Analysis of Dry Matter.

Crude ash,	5.68
" cellulose,	22.99
" fat,	2.81
" protein,	6.22
Non-nitrogenous extract matter,	62.30
	100.00

Fertilizing Constituents.

Moisture,	68.53
Nitrogen,	0.31
Phosphoric acid,	0.055
Potassium oxide,	0.149
Valuation per 2,000 pounds,	$1 12

Corn Stover (1892).

[From station barn.]

	Per Cent.
Moisture at 100° C.,	14.66
Dry matter,	85.34
	100.00

Analysis of Dry Matter.

Crude ash,	5.49
" cellulose,	37.57
" fat,	1.82
" protein,	4.00
Non-nitrogenous extract matter,	51.02
	100.00

Fertilizing Constituents

Moisture,	14.66
Nitrogen,	0.546
Phosphoric acid,	0.228
Potassium oxide,	1.84
Valuation per 2,000 pounds,	$3 55

Soja Bean, green (1892).*

[From station barn.]

	Per Cent.
Moisture at 100° C.,	73.20
Dry matter,	26.80
	100.00

Analysis of Dry Matter.

Crude ash,	6.80
" cellulose,	30.54
" fat,	2.29
" protein,	6.82
Non-nitrogenous extract matter,	53.55
	100.00

Fertilizing Constituents.

Moisture,	73.20
Nitrogen,	0.292
Phosphoric acid,	0.151
Potassium oxide,	0.531
Valuation per 2,000 pounds,	$1 52

Soja Bean Straw, Late Variety (1892).

[From station barn.]

	Per Cent.
Moisture at 100° C.,	7.63
Dry matter,	92.37
	100.00

Analysis of Dry Matter.

Crude ash,	10.72
" cellulose,	36.80
" fat,	3.49
" protein,	5.34
Non-nitrogenous extract matter,	43.65
	100.00

Fertilizing Constituents.

Moisture,	7.63
Nitrogen,	0.789
Phosphoric acid,	0.397
Potassium oxide,	1.322
Valuation per 2,000 pounds,	$4 19

* Late variety.

Cotton-seed Meal.

[I. and II. sent on from Boston, Mass.; III., IV. and V. sent on from Amherst, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	8.62	8.73	8.53	8.83	6.17
Dry matter,	91.38	91.27	91.47	91.17	93.83
	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.					
Crude ash,	6.44	5.94	7.54	4.72	5.34
" cellulose,	6.19	21.05	5.87	9.77	7.68
" fat,	10.69	6.23	11.67	9.47	14.19
" protein,	44.45	26.97	48.23	42.43	44.89
Non-nitrogenous extract matter,	32.23	39.79	26.69	33.61	27.90
	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents.

Moisture,	8.62	8.73	8.53	8.83	6.17
Nitrogen,	6.50	3.94	7.06	6.19	6.74
Phosphoric acid,	4.51	3.41	3.28	2.07	3.26
Potassium oxide,	1.49	1.398	1.37	1.48	1.70
Valuation per 2,000 pounds,	$25 80	$16 84	$26 02	$22 18	$25 34

Cotton-seed Meal.

[From station barn.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	7.05	5.69	6.81
Dry matter,	92.95	94.31	93.19
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	5.40	7.56	7.10
" cellulose,	6.15	7.76	6.54
" fat,	13.82	12.48	12.69
" protein,	38.79	43.69	44.33
Non-nitrogenous extract matter,	35.84	28.51	29.34
	100.00	100.00	100.00

Buffalo Gluten Feed.

[I. sent on from North Amherst, Mass.; II., III. and IV. from station barn.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	8.82	8.97	6.33	6.82
Dry matter,	91.18	91.03	93.67	93.18
	100.00	100.00	100.00	100.00
Analysis of Dry Matter.				
Crude ash,	1.12	0.77	0.95	0.83
" cellulose,	6.17	5.09	5.76	4.94
" fat,	12.86	13.46	12.99	13.03
" protein,	31.05	26.16	25.75	28.71
Non-nitrogenous extract matter,	48.80	54.52	54.55	52.49
	100.00	100.00	100.00	100.00

Gluten Feed.

[I. sent on from Amherst, Mass.; II. sent on from North Amherst, Mass.,; III. sent on from Chicago, Ill.]

	Per Cent.		
	I.	II.*	III.†
Moisture at 100° C.,	6.81	7.87	13.98
Dry matter,	93.19	92.13	86.02
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	1.81	1.97	0.75
" cellulose,	6.39	1.58	1.80
" fat,	11.73	10.48	16.34
" protein,	28.43	25.03	38.68
Non-nitrogenous extract matter,	51.64	60.94	42.43
	100.00	100.00	100.00

* Coon gluten feed. † Pope's gluten feed.

Gluten Meal.

[Sent on from Glen Cove, L. I.]

	Per Cent.
Moisture at 100° C.,	8.80
Dry matter,	91.20
	100.00

Analysis of Dry Matter.

Crude ash,	0.46
" cellulose,	6.10
" fat,	8.49
" protein,	18.18
Non-nitrogenous extract matter,	66.77
	100.00

Dick Gluten Flour.

[Sent on from North Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	7.07
Dry matter,	92.93
	100.00

Analysis of Dry Matter.

Crude ash,	0.91
" cellulose,	1.69
" fat,	17.11
" protein,	33.89
Non-nitrogenous extract matter,	46.40
	100.00

Corn Meal.

[I. sent on from Sherborn, Mass.; II. from station barn.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	12.38	13.96
Dry matter,	87.62	86.04
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	1.76	1.26
" cellulose,	1.92	1.49
" fat,	4.69	3.97
" protein,	10.83	11.11
Non-nitrogenous extract matter,	80.80	82.17
	100.00	100.00

Corn Meal.

[I., yellow corn meal; II., white corn meal; sent on from Salem, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	10.45	7.20
Dry matter,	89.55	92.80
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	0.95	2.47
" cellulose,	2.19	5.01
" fat,	4.62	11.22
" protein,	11.03	11.45
Non-nitrogenous extract matter,	81.21	69.85
	100.00	100.00

Corn Screenings.

[Sent on from Baldwinville, Mass.]

	Per Cent.
Moisture at 100° C.,	11.02
Dry matter,	88.98
	100.00
Analysis of Dry Matter.	
Crude ash,	2.39
" cellulose,	3.27
" fat,	4.48
" protein,	8.29
Non-nitrogenous extract matter,	81.57
	100.00

Corn Germ Meal.

[Sent on from Conway, Mass.]

	Per Cent.
Moisture at 100° C.,	7.55
Dry matter,	92.45
	100.00
Analysis of Dry Matter.	
Crude ash,	0.87
" cellulose,	14.05
" fat,	12.17
" protein,	10.81
Non-nitrogenous extract matter,	62.10
	100.00

Maize Feed.

[From station barn.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	8.80	8.60
Dry matter,	91.20	91.40
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	0.65	0.92
" cellulose,	8.01	7.93
" fat,	6.84	7.90
" protein,	25.69	29.40
Non-nitrogenous extract matter,	58.81	53.85
	100.00	100.00

Wheat Bran.

[From station barn.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	10.01	10.18
Dry matter,	89.99	89.82
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	6.58	6.65
" cellulose,	11.77	12.04
" fat,	5.04	4.49
" protein,	18.06	17.05
Non-nitrogenous extract matter,	58.55	59.77
	100.00	100.00

Starch Feed.

[I. sent on from Boston, Mass.; II. sent on from Chicago, Ill.]

	Per Cent.	
	I.	II.
Moisture at 100° C,	7.37	5.48
Dry matter,	92.63	94.52
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	0.62	0.90
" cellulose,	5.84	15.21
" fat,	12.35	11.30
" protein,	35.61	11.28
Non-nitrogenous extract matter,	45.48	61.31
	100.00	100.00

Oat Feed.

[Sent on from Boston, Mass.]

	Per Cent.
Moisture at 100° C.,	9.34
Dry matter,	90.66
	100.00
Analysis of Dry Matter.	
Crude ash,	4.40
" cellulose,	8.79
" fat,	8.23
" protein,	14.06
Non-nitrogenous extract matter,	66.52
	100.00

Malt Sprouts.

[Sent on from South Acton, Mass.]

	Per Cent.
Moisture at 100° C.,	15.37
Dry matter,	84.63
	100.00
Analysis of Dry Matter.	
Crude ash,	6.31
" cellulose,	14.75
" fat,	3.85
" protein,	27.17
Non-nitrogenous extract matter,	47.92
	100.00

Ground Barley.

[From station barn.]

	Per Cent.
Moisture at 100 C.,	10.91
Dry matter,	89.09
	100.00

Analysis of Dry Matter.

Crude ash,	3.19
" cellulose,	4.10
" fat,	2.13
" protein,	13.33
Non-nitrogenous extract matter,	77.25
	100.00

Chicken Feed (Ground Meat Scraps).

[Sent on from North Hadley, Mass.]

	Per Cent.
Moisture at 100° C.,	3.71
Dry matter,	96.29
	100.00

Analysis of Dry Matter.

Crude ash,	35.61
" cellulose,	–
" fat,	20.31
" protein,	40.08
Non-nitrogenous extract matter,	–

Fertilizing Constituents.

Moisture,	3.71
Nitrogen,	6.51
Phosphoric acid,	2.29
Potassium oxide,	–

II.

FEEDING EXPERIMENTS WITH STEERS (TWO).

1889–92.

Introduction. — The two new feeding experiments briefly described within a few subsequent pages may be considered as a continuation of a preceding one, reported in full in our ninth annual report, 1891–92, pages 107 to 127. They were planned chiefly for the purpose of ascertaining *the cost of the feed for the production of beef for the meat market in case of growing steers, under existing local market conditions of the supply of coarse and fine feed stuffs and of cost of beef.*

During our first experiment in the stated direction, four young steers, grade Shorthorn, two one year old and two two years old, served for our observation. They were selected at different stages of growth, for the *special purpose of observing and comparing the feeding effect of one and the same suitable daily diet on the rate of increase in live weights* and on *the cost of the feed consumed per pound of live weight produced,* under specified conditions.

The *coarse fodder articles used on that occasion* were home raised, and consisted, from the beginning to the end of the trial, of either dry fodder corn, or corn ensilage, or corn stover, all obtained from the same variety of field corn, — Pride of the North. The corn used for the production of dry fodder corn and of corn ensilage was in both cases of a corresponding stage of growth, — kernels glazing. The corn stover was obtained from the fully matured crop.

The *fine* or *grain feed* used in that connection in the preparation of the daily fodder rations consisted, as a rule, of equal weights of either wheat bran and Chicago gluten meal, or of wheat bran and old-process linseed meal, or of wheat bran, old-process linseed meal and corn and cob meal. The total quantity of the grain feed mixture used daily, per head, varied from seven to nine pounds; it never exceeded nine pounds. The amount of coarse feed daily consumed per

head was controlled in every case by the appetite of each animal on trial. Both lots of steers were kept in the stall during the entire time occupied by the observation, — December, 1889, to April, 1890.

The most satisfactory results were noticed in case of both lots, as far as the daily increase in live weight is concerned, when corn ensilage was fed with a mixture of either wheat bran and Chicago gluten meal or of wheat bran and old-process linseed meal. During a period of from six to seven weeks, when feeding the stated feed stuffs, the daily gain in live weights in case of the yearlings reached in one instance as high as 2.9 pounds per head, while in case of the two-year-old steers it amounted under corresponding conditions to 3.45 pounds per head. The live weight of the yearlings at that time was from 650 to 700 pounds each, and that of the older steers from 1,150 to 1,200 pounds each. The *market cost* of the daily fodder rations used at the stated time averaged, per head, in case of the yearlings, 13.79 cents, and *its net* cost was 5.03 cents; while in case of the two older steers the market cost of the daily fodder rations averaged 18 cents per head, and its net cost was 7.04 cents. We paid in case of both lots of young steers $3\frac{1}{2}$ cents per pound of live weight, and sold at the close of the experiments the older lot of steers to the butcher at $3\frac{3}{4}$ cents per pound of live weight. The shrinkage noticed between live weight and dressed weight varied from 34 to 36 per cent. Dressed beef brought at that time from $5\frac{3}{4}$ to 6 cents per pound.

The financial result of the experiment, as far as the highest daily yield of live weight is concerned, at stated market price, may be seen from the following summary: —

SUMMARY.	Yearlings.	Two-year-olds.
Market cost of daily fodder rations,	13.79 cents.	18.00 cents.
Obtainable manurial value per day,	8.76 "	10.96 "
Net cost of daily fodder rations,*	5.03 "	7.04 "
Live weight produced per day,	2.99 lbs.	3.45 lbs.
Cash received for live weight produced per day,	11.21 cents.	12.97 cents.

* Allowing ninety-two per cent. of the manurial value of the feed consumed obtainable.

From these statements it will be noticed that the profit secured by the operation consisted in the value of the obtainable manure and in the disposition of our home-raised fodder articles at fair local retail selling prices. The yearlings proved more remunerative than the two-year-old steers.

Two facts were apparently fairly demonstrated by our first observation, namely: —

1. Yearlings increase at a higher rate in live weight, in case of a corresponding suitable diet, than two-year-old steers, taking the total temporary live weight of the animal on trial as the basis for the comparison. The highest daily increase in the live weight of the yearlings — 650 pounds each — amounted in our first feeding experiment to 0.46 pounds per one hundred pounds of live weight; and in that of the two-year-old steers — 1,150 pounds each — to 0.3 pounds per one hundred pounds of live weight.

2. Our local market price of young steers and of dressed beef necessitates not only an exceptional care in the selection of efficient and low-priced feed stuffs, but also a careful attention in regard to a judicious combination of suitable feed stuffs for the preparation of an economical diet, to render with us the production of beef for the meat market remunerative.

To assist in a desirable solution of that problem is the principal motive for continuing our observation in the stated direction.

Some of the leading features in the management of our *first* feeding experiment are retained in the course pursued during our *second* experiment, which is farther on briefly described. The difference between the latter and the first feeding experiment consists in the following circumstances: —

1. One set of young steers — yearlings — served from the beginning to the end of the experiment.

2. The observation extended over a period of sixteen months, including two succeeding winter seasons, with summer pasturing between them.

3. The animals were kept in the stall, practically without any out-door exercise, during the late autumn, the winter and the earlier part of the spring. During the growing season, from May to the middle of October, they were turned

for support into a good pasture; no additional food from any outside source was offered during that period.

4. A greater variety of coarse and fine fodder articles was used in the preparation of the daily diet at different stages of the experiments during the second winter season than on the preceding occasion.

Second Feeding Experiment with Steers.

December, 1889, to March, 1891.

Two one-year-old steers, grade Shorthorn, of fairly corresponding general condition, served in the trial. They were bought at 3½ cents per pound of live weight. No. 1 weighed 675 pounds, No. 2 weighed 600 pounds, when bought. The systematic feeding began during the middle of December, 1889, both receiving as far as practicable at all times the same daily fodder rations. The mode of feeding was the same as described in the preceding experiment, — twice a day; water was offered two hours after feeding.

The grain-feed part of the daily diet was at all times a definite one, and the same in quantity and quality in case of both animals. The amount of the coarse feed consumed daily was governed by the appetite of each animal. The composition of the daily fodder rations used during the first winter season, 1889–90, differed materially from those used during the second winter season, 1890–91. This circumstance renders it advisable, in the interest of a due appreciation of the feeding results in different stages of the trial, to state our results with reference to its *three distinctly different feeding periods;* namely, feeding record of *first winter season*, of *summer pasturing* and of *second winter season.*

1. *Feeding Record of First Winter Season.*

Dec. 17, 1889, to May 9, 1890.

[Coarse fodder articles: dry fodder corn, corn ensilage, corn stover and sugar beets; fine fodder articles: wheat bran, Chicago gluten meal, old process linseed meal and corn and cob meal.]

Local Market Cost per Ton of the Various Articles of Fodder used.

Wheat bran,	$16 50
Gluten meal, Chicago,	23 00
Old-process linseed meal,	27 50
Corn and cob meal,	16 50
Corn stover,	5 00
Corn ensilage,	2 75
Corn fodder,	7 50
Sugar beets,	5 00

Analyses of the Various Articles of Fodder used.

Food Analyses.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Corn and Cob Meal.	Corn Stover.	Corn Ensilage.	Corn Fodder.	Sugar Beets.
Moisture at 100° C.,	9.27	9.80	9.88	8.10	26.95	72.95	20.42	90.02
Dry matter,	90.73	90.20	90.12	91.90	73.05	27.05	79.58	9.98
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.								
Crude ash,	7.47	1.25	7.39	1.47	5.80	6.48	7.40	11.84
" cellulose,	9.75	1.75	8.74	5.63	34.33	26.33	20.11	8.20
" fat,	5.48	7.00	7.24	3.73	1.66	5.17	1.65	0.71
" protein,	17.53	31.25	36.97	9.79	7.90	7.64	8.31	11.53
Non-nitrogenous extract matter,	59.77	58.75	39.66	79.38	50.31	54.38	62.53	67.72
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

Fertilizer Analyses.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Corn and Cob Meal.	Corn Stover.	Corn Ensilage.	Corn Fodder.	Sugar Beets.
Moisture,	9.27	9.80	9.88	8.10	26.95	72.95	20.42	90.02
Nitrogen,	2.545	4.510	5.331	1.439	0.923	0.330	1.058	0.184
Phosphoric acid,	2.900	0.392	1.646	0.603	0.303	1.138	0.510	0.086
Potassium oxide,	1.637	0.049	1.162	0.441	1.320	0.301	0.760	0.462
Valuation per 2,000 pounds,	$13 60	$16 18	$21 15	$6 02	$4 69	$1 56	$4 89	$1 14

Average Composition of the Daily Fodder Rations used during the Six Successive Feeding Periods (First Winter Season, 1889–90).

I.		II.	
December 17 to December 31.		*January 4 to January 22.*	
Wheat bran (pounds),	2.25	Wheat bran (pounds),	3.88
Gluten meal (pounds),	2.25	Gluten meal (pounds),	3.88
Corn stover (pounds),	12.00	Corn ensilage (pounds),	37.50
Nutritive ratio,	1:5.51	Nutritive ratio,	1:5.49
Total cost (cents),	7.45	Total cost (cents),	12.82
Manurial value obtainable (cents),	5.68	Manurial value obtainable (cents),	8.01
Net cost (cents),	1.77	Net cost (cents),	4.81

III.		IV.	
January 28 to February 16.		*February 21 to March 11.*	
Wheat bran (pounds),	4.00	Wheat bran (pounds),	3.00
Old-process linseed meal (pounds),	4.00	Old-process linseed meal (pounds),	3.00
Corn ensilage (pounds),	43.38	Corn and cob meal (pounds),	3.00
Nutritive ratio,	1:5.69	Corn fodder (pounds),	9.00
Total cost (cents),	14.76	Nutritive ratio,	1:4.93
Manurial value obtainable (cents),	9.50	Total cost (cents),	12.45
Net cost (cents),	5.26	Manurial value obtainable (cents),	7.65
		Net cost (cents),	4.80

V.		VI.	
March 14 to April 21.		*April 24 to May 9.*	
Wheat bran (pounds),	3.00	Wheat bran (pounds),	3.00
Old-process linseed meal (pounds),	3.00	Old-process linseed meal (pounds),	3.00
Corn and cob meal (pounds),	3.00	Corn and cob meal (pounds),	3.00
Corn stover (pounds),	6.00	Corn stover (pounds),	3.60
Nutritive ratio,	1:4.55	Sugar beets (pounds),	20.00
Total cost (cents),	10.58	Nutritive ratio,	1:4.49
Manurial value obtainable (cents),	6.92	Total cost (cents),	14.98
Net cost (cents),	3.66	Manurial value obtainable (cents),	7.44
		Net cost (cents),	7.54

Summary of Cost of the Above-stated Average Daily Fodder Rations used.

[Cents.]

	Feeding Periods.					
	I.	II.	III.	IV.	V.	VI.
Total cost, ...	7.45	12.82	14.76	12.45	10.58	14.98
Manurial value obtainable, .	5.68	8.01	9.50	7.65	6.92	7.44
Net cost,*	1.77	4.81	5.26	4.80	3.66	7.54

* Allowing ninety-two per cent. of the manurial value of the feed consumed obtainable.

As the selling price of live weight per pound of matured steers was $3\frac{3}{4}$ cents, it will be found that, to cover the daily expenses for feed consumed in form of the six stated average daily fodder rations, the following rate of a daily increase, per head, in pounds of live weight, becomes necessary: —

Gain required in Pounds, per Day, of Live Weight, to cover Expenses for Feed.

	Feeding Periods.					
	I.	II.	III.	IV.	V.	VI.
On total cost, ...	1.99	3.42	3.93	3.32	2.82	3.99
On net cost, ...	0.47	1.28	1.40	1.28	0.98	2.01

To what extent the various fodder rations have secured the above-specified increase in live weight may be seen from the subsequent detailed feeding record of each steer on trial: —

Steer No. 1 (Yearling).

Feeding Periods.	Feed consumed (Pounds) per Day.								Total Amount of Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Corn and Cob Meal.	Corn Stover.	Corn Ensilage.	Corn Fodder.	Sugar Beets.					
1889-90.													
Dec. 17 to Dec. 31,	2.27	2.33	–	–	5.27	–	–	–	7.82	1:4.63	675	654	–1.40
Jan. 4 to Jan. 22,	3.88	3.88	–	–	–	37.89	–	–	16.72	1:5.51	667	708	2.16
Jan. 28 to Feb. 16,	4.00	–	4.00	–	–	42.20	–	–	19.30	1:5.63	725	783	2.90
Feb. 21 to March 11,	3.00	–	3.00	3.00	–	–	9.42	–	15.68	1:4.98	785	820	1.84
March 14 to April 21,	3.00	–	3.00	3.00	5.91	–	–	–	12.50	1:4.54	828	880	1.33
April 24 to May 9,	3.00	–	3.00	3.00	3.50	–	–	20.00	12.74	1:4.47	882	895	0.81

	Pounds.
Live weight of animal at the beginning of the experiment,	675.00
Live weight of animal at the close of the experiment,	895.00
Live weight gained during the experiment,	220.00
Average gain in weight per day (entire experiment),	1.53
Highest average gain in live weight per day, III. period,	2.90
Lowest average gain in live weight per day, I. period,	–1.40

Steer No. 2 (Yearling).

FEEDING PERIODS.	Feed consumed (Pounds) per Day.								Total Amount of Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Corn and Cob Meal.	Corn Stover.	Corn Ensilage.	Corn Fodder.	Sugar Beets.					
1889-90.													
Dec. 17 to Dec. 31,	2.00	2.07	–	–	5.27	–	–	–	6.53	1:4.76	600	590	-0.67
Jan. 4 to Jan. 22,	3.88	3.88	–	–	–	37.32	–	–	16.54	1:5.47	610	674	3.37
Jan. 28 to Feb. 16,	4.00	–	4.00	–	–	44.55	–	–	19.97	1:5.75	680	745	3.25
Feb. 21 to March 11,	3.00	–	3.00	3.00	–	–	8.53	–	14.97	1:4.87	746	770	1.26
March 14 to April 21,	3.00	–	3.00	3.00	6.00	–	–	–	12.56	1:4.55	776	826	1.28
April 24 to May 9,	3.00	–	3.00	3.00	3.69	–	–	20.00	12.88	1:4.50	828	840	0.75

	Pounds.
Live weight of animal at the beginning of the experiment,	600.00
Live weight of animal at the close of the experiment,	840.00
Live weight gained during the experiment,	240.00
Average gain in weight per day (entire experiment),	1.07
Highest average gain in live weight per day, II. period,	3.37
Lowest average gain in live weight per day, I. period,	-0.67

The first feeding period in case of both animals shows a decided loss in live weight; this result is presumably largely due to the influence of an entire change in mode of keeping and feeding, and cannot be charged to the daily diet.

2. Record of Summer Pasturing.

May 10, 1890, to Sept. 30, 1890.

	No. 1.	No. 2.
Date of turning steers into pasture,	May 10, 1890.	May 10, 1890.
Date of closing pasturing,	Sept. 30, 1890.	Sept. 30, 1890.
Number of days of pasturing,	144	144
Live weight of steers when turned into pasture,	895 lbs.	840 lbs.
Live weight of steers at close of pasturing,	1,020 "	923 "
Total weight gain during pasturing,	125 "	83 "
Average gain in weight per day,	0.87 "	0.58 "
Cost of feed per day, allowing forty cents per week for use of pasture,	5.71 cts.	5.71 cts.
Cost of feed per pound of live weight gained,	6.58 "	9.91 "

To meet the expenses for the use of the pasture, per head, forty cents a week, requires a daily increase in live weight of 1.52 pounds, or about twice as much as we actually secured. The daily increase in live weight no doubt varies during the season more or less, in consequence of changes in the weather and in the condition of the pasture. A mere statement of the final results at the close of the season does not show the degree of temporary adverse influence. Aside from these circumstances, there is, however, another serious source of loss in live weight; apparently unavoidably connected with a system of changing from stall feeding to pasturing, and from the latter again to stall feeding. The loss in

live weight due to these changes amounted in our case to from twenty to twenty-five pounds, per head, on each occasion and in case of both animals.

3. Feeding Record of Second Winter Season.

Oct. 14, 1890, to March 3, 1891.

[Coarse fodder articles: upland meadow hay, barley straw, clover hay, corn ensilage, turnips; fine fodder articles: barley meal, wheat bran, cotton-seed meal.]

The steers, upon returning from the pasture, September 30, were allowed for a week or more, some hours every day, an out-door exercise, to make the change for a subsequent close confinement and a systematic system of feeding a gradual one. The mode of feeding was the same as during the preceding winter season. The daily grain-feed rations consisted either of wheat bran and cotton-seed meal, 3.5 pounds each, per head, or of wheat bran, barley meal and cotton-seed meal, varying from 3 to 3.5 pounds each, per head, at different times. The daily coarse-feed ration consisted at different times in varying proportions either of English hay, or of English hay and barley straw, or of English hay, clover hay and turnips, or of clover hay and corn ensilage; the amount consumed was controlled by the appetite of each animal on trial. The subsequent detailed statement of fodder rations used represents in each case the average composition of the daily diet during succeeding feeding periods. The change from one daily diet to another is in all cases a gradual one, to avoid as far as practicable serious disturbances in digestion.

Local Market Cost per Ton of the Various Articles of Fodder used.

Wheat bran,	$23 50
Barley meal,	30 00
Cotton-seed meal,	27 50
Barley straw,	5 00
Hay,	15 00
Clover hay,	12 00
Turnips,	4 00
Corn ensilage,	2 75

Analyses of the Various Articles of Fodder used.

Food Analyses.	Wheat Bran.	Barley Meal.	Cotton-seed Meal.	Barley Straw.	Hay.	Clover Hay.	Turnips.	Corn Ensilage.
Moisture at 100° C.,	12.11	14.62	10.13	11.44	9.72	17.41	89.32	80.53
Dry matter,	87.89	85.38	89.87	88.56	90.28	82.59	10.68	19.47
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.								
Crude ash,	7.40	3.18	8.22	5.30	6.43	14.98	9.54	6.73
" cellulose,	12.17	5.04	7.26	33.85	32.28	30.37	12.61	26.90
" fat,	5.04	2.38	11.64	3.38	2.49	1.75	2.05	3.27
" protein,	18.48	14.93	45.99	9.24	9.54	16.64	9.89	8.97
Non-nitrogenous extract matter,	56.91	74.47	26.89	48.23	49.26	36.26	65.91	54.13
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

Fertilizer Analyses.	Wheat Bran.	Barley Meal.	Cotton-seed Meal.	Barley Straw.	Hay.	Clover Hay.	Turnips.	Corn Ensilage.
Moisture,	12.11	14.62	10.13	11.44	9.72	17.41	89.32	80.53
Nitrogen,	2.697	2.04	6.613	1.310	1.379	2.20	1.69	0.279
Phosphoric acid,	2.870	0.660	2.090	0.303	0.352	0.603	0.092	0.096
Potassium oxide,	1.620	0.341	1.620	2.086	1.541	1.962	0.358	0.226
Valuation per 2,000 pounds,	$12 71	$7 16	$23 60	$6 14	$5 92	$9 03	$0 93	$1 15

Average Composition of the Daily Fodder Rations used during the Six Successive Feeding Periods (Second Winter Season, 1890–91).

I.		II.	
October 14 to October 25.		*October 28 to November 10.*	
Wheat bran (pounds),	3.50	Wheat bran (pounds),	3.50
Cotton-seed meal (pounds),	3.50	Cotton-seed meal (pounds),	3.50
Barley straw (pounds),	6.42	Hay (pounds),	15.68
Hay (pounds),	8.33	Nutritive ratio,	1:4.08
Nutritive ratio,	1:4.15	Total cost (cents),	20.68
Total cost (cents),	16.78	Manurial value obtainable (cents),	10.11
Manurial value obtainable (cents),	9.93	Net cost (cents),	10.57
Net cost (cents),	6.85		

III.		IV.	
November 13 to December 1.		*December 2 to December 15.*	
Wheat bran (pounds),	2.50	Wheat bran (pounds),	2.50
Cotton-seed meal (pounds),	3.50	Barley meal (pounds),	2.50
Hay (pounds),	7.53	Cotton-seed meal (pounds),	2.50
Clover hay (pounds),	7.72	Hay (pounds),	7.04
Turnips (pounds),	30.00	Clover hay (pounds),	6.15
Nutritive ratio,	1:3.75	Turnips (pounds),	30.00
Total cost (cents),	25.2	Nutritive ratio,	1:4.28
Manurial value obtainable (cents),	12.38	Total cost (cents),	25.10
Net cost (cents),	12.82	Manurial value obtainable (cents),	10.75
		Net cost (cents),	14.35

V.		VI.	
December 16 to January 19.		*January 27 to March 2.*	
Wheat bran (pounds),	3.32	Wheat bran (pounds),	3.00
Barley meal (pounds),	3.32	Barley meal (pounds),	3.00
Cotton-seed meal (pounds),	3.32	Cotton-seed meal (pounds),	3.00
Hay (pounds),	6.44	Clover hay (pounds),	5.07
Clover hay (pounds),	5.34	Corn ensilage (pounds),	42.45
Turnips (pounds),	30.00	Nutritive ratio,	1:4.11
Nutritive ratio,	1:4.01	Total cost (cents),	21.05
Total cost (cents),	27.48	Manurial value obtainable (cents),	10.34
Manurial value obtainable (cents),	11.89	Net cost (cents),	10.71
Net cost (cents),	15.59		

Summary of Cost of the Above-stated Average Daily Fodder Rations used.

[Cents.]

	Feeding Periods.					
	I.	II.	III.	IV.	V.	VI.
Total cost,	16.78	20.68	25.20	25.10	27.48	21.05
Manurial value obtainable,	9.93	10.11	12.38	10.75	11.89	10.34
Net cost,*	6.85	10.57	12.82	14.35	15.59	10.71

* Allowing ninety-two per cent. of the manurial value of the feed consumed obtainable.

Taking the selling price of dressed beef at $3\frac{3}{4}$ cents per pound, it follows that, to cover the daily expenses for feed consumed in the form of the above specified six daily fodder rations, the following rate of daily increase in pounds of live weight becomes necessary: —

Gain required in Pounds, per Day, of Live Weight, to cover Expenses for Feed.

	Feeding Periods.					
	I.	II.	III.	IV.	V.	VI.
On total cost,	4.47	5.51	6.72	6.69	7.33	5.61
On net cost,	1.83	2.82	3.42	3.83	4.16	2.86

The subsequent detailed record of each steer on trial shows to what extent each of the previously specified fodder rations has realized the required increase in live weight.

Conclusions.

1. The rate of increase in live weight was highest during the first winter season, 1889–90. The daily increase in live weight averaged in case of steer No. 1, 2.5 pounds, and in the case of steer No. 2, 3.3 pounds, for a period of six weeks, when fodder rations II. and III. were fed. The market value of the stated daily increase in live weight, at $3\frac{3}{4}$ cents per pound, would amount to 9.4 cents in case of steer No. 1, and to 12.4 cents in case of steer No. 2. As the market cost of these two fodder rations averages 13.8 cents and

their net cost 5.03 cents, it will be noticed that the value gained by the stated increase in live weight does in neither case pay fully for the food consumed for its production; yet there remains a noticeable margin of profit on the net cost of the daily feed in the form of obtainable manure; *i. e.*, 4.37 cents per day in case of steer No. 1, and 7.37 cents in case of steer No. 2.

2. The average of the daily increase in the live weight of the steers during the entire period of pasture feeding amounted, in case of steer No. 1, to .87 pounds, and in the case of steer No. 2 to .58 pounds. This increase in live weight represents on an average a market value of 3.18 cents in case of the former, and in that of the latter of 2.18 cents. Our expenses for the use of the pasture, per head, was 40 cents per week, or 5.7 cents per day. We lost, per head, 3 cents per day, or 21 cents per week, on each animal; not counting expenses for transportation to and from the pasture, loss of interest on the investment, etc.

3. The financial results of the second winter feeding are less satisfactory than those secured during the first winter feeding. This fact is due to two circumstances, namely, higher market cost of several coarse and fine fodder articles used, and less nutritive effect of the fodder rations experimented with. The daily increase in live weight did at no time exceed 2.33 pounds per head. The market cost of the various daily fodder rations used during the time stated varied from 16.8 cents to 27.48 cents per head, while their net cost differed from 6.85 cents to 15.59 cents. The highest temporary increase in live weight noticed, per day, 2.33 pounds, would realize in our market only 12.37 cents, which amount is still 4.5 cents less than the market cost of the cheapest daily fodder ration, I. period, used.

The results of the second feeding experiment emphasize the statements made in connection with the report of our first experiment, namely, cheaper and more efficient fodder rations than most of our grass lands — meadows and pastures — can furnish have to be devised to render the production of beef for our meat markets remunerative.

Our observations with growing steers have been continued, and feeding experiments carried on without the assistance of summer pasturing are well advanced.

Steer No. 1.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.								Total Amount of Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Barley Meal.	Cotton-seed Meal.	Barley Straw.	Hay.	Clover Hay.	Turnips.	Corn Ensilage.					
1890-91.													
Oct. 14 to Oct. 25,	3.50	–	3.50	7.00	8.33	–	–	–	19.96	1:4.22	1,060	1,085	2.08
Oct. 28 to Nov. 10,	3.50	–	3.50	–	16.53	–	–	–	21.16	1:4.16	1,095	1,083	-0.75
Nov. 13 to Dec. 1,	3.50	–	3.50	–	8.00	8.10	30.00	–	23.35	1:3.78	1,096	1,140	2.32
Dec. 2 to Dec. 15,	2.50	2.50	2.50	–	8.00	7.00	30.00	–	22.79	1:4.34	1,140	1,165	1.79
Dec. 16 to Jan. 19,	3.50	3.50	3.50	–	7.13	6.14	30.00	–	23.94	1:3.99	1,165	1,238	2.09
Jan. 27 to March 2,	3.00	3.00	3.00	–	–	4.91	–	49.40	21.59	1:4.28	1,240	1,320	2.29

	Pounds.
Weight of animal at the beginning of the experiment,	1,020.00
Weight of animal at the time of killing,	1,328.00
Live weight gained during the experiment,	308.00
Average gain in weight per day (entire experiment),	1.90
Highest average gain in live weight per day, III. period,	2.32
Lowest average gain in live weight per day, II. period,	-0.75

Steer No. 2.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.								Total Amount of Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Barley Meal.	Cotton-seed Meal.	Barley Straw.	Hay.	Clover Hay.	Turnips.	Corn Ensilage.					
1890-91.													
Oct. 14 to Oct. 25,	3.50	–	3.50	5.83	8.33	–	–	–	18.92	1 : 4.07	980	1,008	2.33
Oct. 28 to Nov. 10,	3.50	–	3.50	–	14.82	–	–	–	19.62	1 : 4.00	1,018	1,012	-0.43
Nov. 13 to Dec. 1,	3.50	–	3.50	–	7.05	7.31	30.00	–	21.86	1 : 3.72	1,022	1,040	0.95
Dec. 2 to Dec. 15,	2.50	2.50	2.50	–	6.07	5.29	30.00	–	19.64	1 : 4.23	1,040	1,053	0.93
Dec. 16 to Jan. 19,	3.14	3.14	3.14	–	5.74	4.54	30.00	–	20.41	1 : 4.02	1,053	1,120	1.91
Jan. 27 to March 2,	3.00	3.00	3.00	–	–	5.23	–	35.50	19.14	1 : 3.93	1,125	1,155	0.85

	Pounds.
Weight of animal at the beginning of the experiment,	923.00
Weight of animal at the time of killing,	1,154.00
Live weight gained during the experiment,	231.00
Average gain in weight per day (entire experiment),	1.43
Highest average gain in live weight per day, I. period,	2.33
Lowest average gain in live weight per day, II. period,	-0.43

Third Feeding Experiment with Steers.

October, 1890, to May, 1892.

Three one-year-old steers, grade Shorthorn, were selected for the trial. They were bought at $3\frac{1}{2}$ cents per pound of live weight on Oct. 14, 1890. No. 1 weighed 655 pounds, No. 2 weighed 595 pounds and No. 3 weighed 629 pounds.

The mode of feeding and the general management of the third experiment corresponded in all essentials with the course adopted in the second feeding experiment, previously described. The third experiment is divided, as the second, and for similar reasons, into three distinctly different stages of progress, namely, *feeding record* of *first winter season*, of *summer pasturing* and of *second winter season*.

1. *Feeding Record of First Winter Season.*

Oct. 14, 1890, to April 20, 1891.

[Coarse fodder articles: upland meadow hay, barley straw, clover hay, corn ensilage and turnips; fine fodder articles: wheat bran and cotton-seed meal.]

Local Market Cost per Ton of the Various Articles of Fodder used.

Wheat bran,	$23 50
Cotton-seed meal,	27 50
Barley straw,	5 00
Hay,	15 00
Mixed fodder,	12 00
Turnips,	7 00
Corn ensilage,	2 75

Analyses of the Various Articles of Fodder used.

Food Analyses.	Wheat Bran.	Cotton-seed Meal.	Barley Straw.	Hay.	Mixed Fodder.	Turnips.	Corn Ensilage.
Moisture at 100° C.,	12.11	10.13	11.44	9.72	17.41	89.32	80.53
Dry matter,	87.89	89.87	88.56	90.28	82.59	10.68	19.47
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.							
Crude ash,	7.40	8.22	5.30	6.43	14.98	9.54	6.73
" cellulose,	12.17	7.26	33.85	32.28	30.37	12.61	26.90
" fat,	5.04	11.64	3.38	2.49	1.75	2.05	3.27
" protein,	18.48	45.99	9.24	9.54	16.64	9.89	8.97
Non-nitrogenous extract matter,	56.91	26.89	48.23	49.26	36.26	65.91	54.13
	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

Fertilizer Analyses.	Wheat Bran.	Cotton-seed Meal.	Barley Straw.	Hay.	Mixed Fodder.	Turnips.	Corn Ensilage.
Moisture,	12.11	10.13	11.44	9.72	17.41	89.32	80.53
Nitrogen,	2.60	6.613	1.31	1.379	2.20	0.169	0.279
Phosphoric acid,	2.87	2.09	0.303	0.352	0.603	0.092	0.096
Potassium oxide,	1.62	1.62	2.086	1.541	1.962	0.358	0.226
Valuation per 2,000 pounds,	$12 42	$23 60	$6 14	$5 92	$9 03	$0 93	$1 15

Average Composition of the Daily Fodder Rations used during the Seven Successive Feeding Periods (First Winter Season, 1890–91).

I.		II.	
October 14 to October 25.		*Octobcr 28 to November 10.*	
Wheat bran (pounds),	2.00	Wheat bran (pounds),	2.00
Cotton-seed meal (pounds),	2.00	Cotton-seed meal (pounds),	2.00
Barley straw (pounds),	4.67	Hay (pounds),	11.50
Hay (pounds),	5.95	Nutritive ratio,	1:4.48
Nutritive ratio,	1:4.56	Total cost (cents),	13.73
Total cost (cents),	10.73	Manurial value obtainable (cents),	6.47
Manurial value obtainable (cents),	6.27	Net cost (cents),	7.26
Net cost (cents),	4.46		

III.		IV.	
November 13 to December 15.		*December 16 to January 19.*	
Wheat bran (pounds),	2.00	Wheat bran (pounds),	3.00
Cotton-seed meal (pounds),	2.00	Cotton-seed meal (pounds),	3.00
Hay (pounds),	5.43	Hay (pounds),	5.08
Mixed fodder (pounds),	5.66	Mixed fodder (pounds),	4.83
Turnips (pounds),	20.00	Turnips (pounds),	20.00
Nutritive ratio,	1:3.94	Nutritive ratio,	1:3.51
Total cost (cents),	16.57	Total cost (cents),	18.36
Manurial value obtainable (cents),	8.02	Manurial value obtainable (cents),	9.26
Net cost (cents),	8.55	Net cost (cents),	9.10

Average Composition, etc. — Concluded.

V.		VI.	
January 27 to March 6.		*March 10 to March 24.*	
Wheat bran (pounds),	3.00	Wheat bran (pounds),	3.00
Cotton-seed meal (pounds),	3.00	Cotton-seed meal (pounds),	3.00
Mixed fodder (pounds),	5.33	Hay (pounds),	6.84
Corn ensilage (pounds),	33.25	Mixed fodder (pounds),	6.52
Nutritive ratio,	1:3.46	Nutritive ratio,	1:3.24
Total cost (cents),	15.44	Total cost (cents),	16.66
Manurial value obtainable (cents),	8.99	Manurial value obtainable (cents),	9.52
Net cost (cents),	6.45	Net cost (cents),	7.14

VII.	
March 25 to April 20.	
Wheat bran (pounds),	5.00
Cotton-seed meal (pounds),	3.00
Hay (pounds),	11.00
Nutritive ratio,	1:3.78
Total cost (cents),	16.69
Manurial value obtainable (cents),	9.58
Net cost (cents),	7.11

Summary of Cost of the Above-stated Average Daily Fodder Rations used.

[Cents.]

	Feeding Periods.						
	I.	II.	III.	IV.	V.	VI.	VII.
Total cost,	10.73	13.73	16.57	18.36	15.44	16.66	16.69
Manurial value obtainable,	6.27	6.47	8.02	9.26	8.99	9.52	9.58
Net cost,*	4.46	7.26	8.55	9.10	6.45	7.14	7.11

* Allowing ninety-two per cent. of the manurial value of the feed consumed obtainable.

Accepting as basis of calculation the selling price of dressed beef, $3\frac{3}{4}$ cents per pound, it will be noticed that, to cover the daily expenses for feed consumed in form of the previously specified seven daily fodder rations, the following rates in the daily increase in pounds of live weight become necessary: —

Gain required in Pounds, per Day, of Live Weight, to cover Expenses for Feed.

	Feeding Periods.						
	I.	II.	III.	IV.	V.	VI.	VII.
On total cost, . .	2.86	3.66	4.42	4.89	4.12	4.44	4.45
On net cost, . .	1.19	1.93	2.28	2.43	1.72	1.90	1.90

The following detailed record of each steer on trial shows to what extent each of the previously described fodder rations has materialized the necessary increase in live weight: —

Steer No. 1 (Yearling).

FEEDING PERIODS.	Feed consumed (Pounds) per Day.							Total Amount of Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Cotton-seed Meal.	Barley Straw.	Hay.	Mixed Fodder.	Turnips.	Corn Ensilage.					
1890-91.												
Oct. 14 to Oct. 25,	2.00	2.00	5.00	6.33	–	–	–	13.71	1:4.68	655	685	2.50
Oct. 28 to Nov. 10,	2.00	2.00	–	11.46	–	–	–	13.92	1:4.47	693	692	-0.07
Nov. 13 to Dec. 15,	2.00	2.00	–	5.27	5.42	20.00	–	14.95	1:3.93	697	746	2.50
Dec. 16 to Jan. 19,	3.00	3.00	–	5.06	5.23	20.00	–	16.38	1:3.51	746	784	1.09
Jan. 27 to March 6,	3.00	3.00	–	–	5.33	–	34.46	16.46	1:3.62	788	825	0.95
March 10 to March 21,	3.00	3.00	–	5.87	6.43	–	–	15.96	1:3.13	822	851	1.93
March 25 to April 20,	5.00	3.00	–	10.57	–	–	–	16.66	1:3.74	851	853	0.07

	Pounds.
Live weight of animal at the beginning of the experiment,	655.00
Live weight of animal at the close of the experiment,	853.00
Live weight of animal gained during the experiment,	198.00
Average gain of weight per day (entire experiment),	1.05
Highest average gain in live weight per day, I. period,	2.50
Lowest average gain in live weight per day, II. period,	-0.07

Steer No. 2 (Yearling).

FEEDING PERIODS.	Feed consumed (Pounds) per Day.							Total Amount of Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Cotton-seed Meal.	Barley Straw.	Hay.	Mixed Fodder.	Turnips.	Corn Ensilage.					
1890-91.												
Oct. 14 to Oct. 25,	2.00	2.00	3.88	5.42	–	–	–	11.90	1:4.31	593	602	0.75
Oct. 28 to Nov. 10,	2.00	2.00	–	10.61	–	–	–	13.15	1:4.35	605	630	1.79
Nov. 13 to Dec. 15,	2.00	2.00	–	5.29	5.45	20.00	–	15.00	1:3.93	633	690	1.73
Dec. 16 to Jan. 19,	3 00	3.00	–	5.11	4.11	20.00	–	15.49	1:3.52	690	735	1.29
Jan. 27 to March 6,	3.00	3.00	–	–	5.27	–	29.51	15.45	1:3.10	755	798	1.10
March 10 to March 24,	3.00	3.00	–	7.13	5.73	–	–	16.52	1:3.28	794	838	2.93
March 25 to April 20,	5.00	3.00	–	10.41	–	–	–	16.52	1:3.72	838	843	0.19

	Pounds.
Live weight of animal at the beginning of the experiment,	593.00
Live weight of animal at the close of the experiment,	843.00
Live weight gained during the experiment,	250.00
Average gain in weight per day (entire experiment),	1.32
Highest average gain in live weight per day, VI. period,	2.93
Lowest average gain in live weight per day, VII. period,	0.19

Steer No. 3 (Yearling).

Feeding Periods.	Feed consumed (Pounds) per Day.							Total Amount of Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Cotton-seed Meal.	Barley Straw.	Hay.	Mixed Fodder.	Turnips.	Corn Ensilage.					
1890-91.												
Oct. 14 to Oct. 25,	2.00	2.00	5.13	6.12	–	–	–	13.64	1:4.68	626	647	1.75
Oct. 28 to Nov. 10,	2.00	2.00	–	12.54	–	–	–	14.89	1:4.62	655	675	1.43
Nov. 13 to Dec. 15,	2.00	2.00	–	5.73	6.12	20.00	–	15.93	1:3.97	681	715	1.03
Dec. 16 to Jan. 19,	3.00	3.00	–	5.00	5.14	20.00	–	16.25	1:3.50	715	760	1.29
Jan. 27 to March 6,	3.00	3.00	–	–	5.38	–	35.67	16.73	1:3.66	741	836	2.44
March 10 to March 24,	3.00	3.00	–	7.53	7.40	–	–	18.26	1:3.32	830	878	3.20
March 25 to April 20,	5.00	3.00	–	11.80	–	–	–	17.77	1:3.87	878	870	-0.30

	Pounds.
Live weight of animal at the beginning of the experiment,	626.00
Live weight of animal at the close of the experiment,	870.00
Live weight gained during the experiment,	244.00
Average gain in weight per day (entire experiment),	1.29
Highest average gain in live weight per day, VI. period,	3.20
Lowest average gain in live weight per day, VII. period,	-0.30

2. *Record of Summer Pasturing.*

April 27, 1891, to Nov. 3, 1891.

	No. 1.	No. 2.	No. 3.
Date of turning steers into pasture, . .	April 27, 1891.	April 27, 1891.	April 27, 1891.
Date of closing pasturing, ...	Nov. 3, 1891.	Nov. 3, 1891.	Nov. 3, 1891.
Number of days of pasturing, . . .	190	190	190
Live weight of steers when turned into pasture, ...	830 lbs.	805 lbs.	848 lbs.
Live weight of steers at close of pasturing, .	925 "	926 "	955 "
Total weight gained during pasturing, . .	95 "	121 "	107 "
Average gain in weight per day, . . .	0.50 "	0.64 "	0.56 "
Cost of feed, allowing twenty-five cents per week for use of pasture, ...	$6 78	$6 78	$6 78
Cost of feed per pound of live weight gained,	7.14 cts.	5.60 cts.	6.33 cts.

The average gain in live weight per day, per head, was 0.95 pounds. To meet the expenses for the use of the pasture, which was 25 cents, per head, for the week, requires an increase in live weight of one pound, leaving our outlay for moving the steers to the pasture and back again without a return. Adding to this result the unavoidable falling off in live weight, due to a change in mode of living, it is apparent that pasturing without an additional supply of feed from outside sources is apt to prove an unprofitable delay in the maturing of young steers for the meat market.

To demonstrate, if possible, the correctness of this view, our more recent experiments with feeding young steers for the meat market are carried on without the assistance of the pasture. The animal is fed in the stable during the entire experiment, without any out-door exercise beyond the requirements of good health.

3. *Feeding Record of Second Winter Season.*

Nov. 10, 1891, to May 16, 1892.

[Coarse fodder articles: upland meadow hay, dent corn ensilage, sweet corn ensilage, corn stover, sugar beets, globe mangolds and turnips; fine fodder articles: wheat bran, maize feed (Chicago) and gluten feed (Buffalo).]

The steers returning from the pasture November 3, were for a week allowed out-door exercise between the times of feeding, to make the change for subsequent close confinement a gradual one.

The system of feeding remained materially the same as on previous occasion. The daily ration of grain feed was a definite one for each period, and the same in quantity for each animal at the time. It consisted during the first five periods of equal weights of wheat bran and Chicago maize feed, from 3.44 to 4 pounds each, and during the last feeding period (VI.) of equal weights of wheat bran and Buffalo gluten feed, 4 pounds each, per head, daily. The daily coarse fodder ration consisted at different times of either English hay with roots, or of corn ensilage. The amount of roots was a definite one, and the same in case of all animals; while the daily amount of hay and of corn ensilage consumed was controlled by the appetite of each steer.

The following detailed description of the six fodder rations fed during the succeeding feeding periods represents the average composition of the daily diet. Changes from one diet to another were made gradually for obvious reasons, allowing six days to pass by before recording results.

Local Market Cost per Ton of the Various Articles of Fodder used.

Wheat bran,	$22 00
Maize feed,	25 00
Gluten feed,	23 00
Hay,	15 00
Turnips,	2 50
Globe mangolds,	4 00
Dent corn ensilage,	2 50
Sweet corn ensilage,	2 50
Corn stover,	5 00
Sugar beets,	5 00

Analyses of Fine Feed used.

[Grain Feed]

Food Analyses.	Wheat Bran.	Maize Feed.	Gluten Feed.
Moisture at 100° C.,	10.01	8.70	8.97
Dry matter,	89.99	91.30	91.03
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	6.58	0.78	0.77
" cellulose,	11.77	7.97	5.09
" fat,	5.04	7.37	13.46
" protein,	18.06	27.55	26.16
Non-nitrogenous extract matter,	58.55	56.33	54.52
	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

Fertilizer Analyses.	Wheat Bran.	Maize Feed.	Gluten Feed.
Moisture,	10.01	8.70	8.97
Nitrogen,	2.60	4.03	3.81
Phosphoric acid,	2.85	0.70	0.69
Potassium oxide,	1.63	0.43	0.42
Valuation per 2,000 pounds,	$12 40	$13 25	$12 57

Analyses of Coarse Fodder Articles used.

Food Analyses.	Hay.	Turnips.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.	Corn Stover.	Sugar Beets.
Moisture at 100° C.,	9.72	90.21	87.75	79.92	84.30	20.10	85.27
Dry matter,	90.28	9.79	12.25	20.08	15.70	79.90	14.73
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.							
Crude ash,	6.43	8.47	9.06	4.99	6.32	6.12	5.95
" cellulose,	32.28	11.23	7.94	27.19	29.32	33.72	6.49
" fat,	2.49	1.74	0.88	3.29	7.36	2.51	0.66
" protein,	9.54	10.12	10.37	8.29	7.86	7.75	10.97
Non-nitrogenous extract matter,	49.26	68.44	71.75	56.24	49.14	49.90	75.93
	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound]

Fertilizer Analyses.	Hay.	Turnips.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.	Corn Stover.	Sugar Beets.
Moisture,	9.72	90.21	87.75	79.92	84.30	20.10	85.27
Nitrogen,	1 38	0.178	0 203	0.27	0.20	0.99	0.26
Phosphoric acid,	0.36	0.104	0.093	0.14	0.089	0.29	0 10
Potassium oxide,	1 57	0 385	0.383	0.33	0 41	1 40	0.48
Valuation per 2,000 pounds,	$5 95	$0 99	$1 06	$1 26	$1 06	$4 55	$1 32

Average Composition of the Daily Fodder Rations used during the Six Successive Feeding Periods (Second Winter Season, 1891–92).

I.		II.	
November 10 to December 22.		*December 29 to January 30.*	
Wheat bran (pounds),	3.44	Wheat bran (pounds),	4.00
Maize feed (pounds),	3.44	Maize feed (pounds),	4.00
Hay (pounds),	11.03	Hay (pounds),	9.17
Turnips (pounds),	17.38	Globe mangolds (pounds),	15.00
Nutritive ratio,	1:5.83	Nutritive ratio,	1:5.42
Total cost (cents),	18.53	Total cost (cents),	19.28
Manurial value obtainable (cents),	7.87	Manurial value obtainable (cents),	7.95
Net cost (cents),	10.66	Net cost (cents),	11.33

III.		IV.	
January 19 to February 23.		*March 1 to March 23.*	
Wheat bran (pounds),	4.00	Wheat bran (pounds),	4.00
Maize feed (pounds),	4.00	Maize feed (pounds),	4.00
Dent corn ensilage (pounds),	33.88	Sweet corn ensilage (pounds)	57.41
Nutritive ratio,	1:5.25	Nutritive ratio,	1:5.92
Total cost (cents),	13.64	Total cost (cents),	16.58
Manurial value obtainable (cents),	6.68	Manurial value obtainable (cents),	7.52
Net cost (cents),	6.96	Net cost (cents),	9.06

Average Composition, etc. — Concluded.

V.		VI.	
March 29 to April 9.		*April 26 to May 16.*	
Wheat bran (pounds),	4.00	Wheat bran (pounds),	4.00
Maize feed (pounds),	4.00	Gluten feed (pounds),	4.00
Corn stover (pounds),	11.23	Hay (pounds),	10.00
Nutritive ratio,	1:5.67	Sugar beets (pounds),	15.00
Total cost (cents),	12.21	Nutritive ratio,	1:5.83
Manurial value obtainable (cents),	7.06	Total cost (cents),	20.25
Net cost (cents),	5.15	Manurial value obtainable (cents),	8.24
		Net cost (cents),	12.01

Summary of Cost of the Above-stated Average Daily Fodder Rations used.

[Cents.]

	Feeding Periods.					
	I	II.	III.	IV.	V.	VI
Total cost,	18.53	19.28	13.64	16.58	12.21	20.25
Manurial value obtainable,	7.87	7.95	6.68	7.52	7.06	8.24
Net cost,*	10.66	11.33	6.96	9.06	5.15	12.01

* Allowing ninety-two per cent. of the manurial value of the feed consumed obtainable.

Gain required in Pounds, per Day, of Live Weight, to cover Expenses for Feed.

	Feeding Periods.					
	I.	II.	III.	IV.	V.	VI.
On total cost,	4.94	5.14	3.64	4.42	3.26	5.40
On net cost,	2.84	3.02	1.86	2.42	1.37	3.20

How far in the case of each steer these rates of daily increase in their live weight have been realized in case of each specified fodder ration may be seen from the subsequent detailed feeding record of each animal.

Conclusions.

The results of the third feeding experiment with young steers do not materially differ in their general aspect from those obtained in our two preceding experiments.

1. During the first winter season the daily gain in live weight during the sixth feeding period reached 3.2 pounds (steer No. 3), and it averaged for the entire lot of steers (three) at that time 2.69 pounds per head. This gain represents 0.34 pounds on every one hundred pounds of live weight of the animal on trial (800 pounds each).

2. During the second winter season the same lot of steers gained, during one feeding period (I. period), on an average, 2.5 pounds of live weight per day; in case of one steer it was as high as 3.05 pounds per day. This rate of daily increase in live weight is equal to 0.21 pounds on each hundred pounds of live weight, with a total weight of 1,100 pounds per head.

3. The total local market cost of the different stated daily fodder rations used during the first winter season varies from 10.7 to 18.36 cents, and their net cost from 4.46 to 9.10 cents, leaving manurial refuse equal in commercial value to one-half of the local retail market cost of the feed consumed.

4. The total local market cost of the daily fodder rations used during the second winter season varies from 12.2 to 20.28 cents, and their net cost from 5.1 to 12.01 cents, leaving a manurial refuse equal to two-fifths of the local retail market cost of the fodder articles which constitute the stated fodder rations.

5. The average daily gain in live weight, taking the entire experiment into consideration, is somewhat higher than that noticed in the second experiment; yet at no period of the trial does the daily increase in live weight at $3\frac{3}{4}$ cents market cost per pound of live weight equal the entire local market cost of the feed consumed in connection with its production. This result is due in some degree, no doubt, to the contemporary high local market cost of some of the fodder ingredients largely used in the making up of the daily fodder rations.

The results of our experiments in this connection are, as may be noticed from preceding reports, rather more instructive than remunerative. A market cost of $3\frac{1}{2}$ cents per pound of live weight in cases of yearlings, with $3\frac{3}{4}$ cents per pound of live weight in cases of matured steers, leaves, it will be conceded, but a small margin of cash profits. The largest daily increase in live weight, in case of any diet thus far experimented with, was 0.46 pounds per one hundred pounds of live weight, with yearlings weighing from 650 to 700 pounds per head; while in case of two-year-old steers, weighing from 1,100 to 1,150 pounds per head, it reached but 0.3 pounds for every one hundred pounds of their live weight. The highest daily increase in live weight during any feeding period in case of yearlings thus far secured by us amounted to 2.9 pounds per head, and in case of two-year-olds to 3.4 pounds per head. These results represent a market value of live weight gained at above-stated local meat market prices of 10.87 cents in case of yearlings, and 12.55 cents in case of two-year-old steers. Our results fall behind daily, thus far, about one pound of gain in live weight to cover the market cost of the feed consumed for its production; 14 to 15 cents in case of yearlings, 18 to 19 cents in case of two-year-old steers.

The necessity of efficient and cheap fodder rations being quite evident, it seems desirable to try, more generally, fodder crops of a higher nutritive character than the majority of our meadows and pastures furnishes at present.

Steer No. 1.

Feeding Periods.	Feed consumed (Pounds) per Day.										Total Amount of Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Maize Feed.	Gluten Feed.	Hay.	Turnips.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.	Corn Stover.	Sugar Beets.					
1891-92.															
Nov. 10 to Dec. 22,	3.44	3.44	–	12.17	17.38	–	–	–	–	–	18.92	1:5.91	925	1,020	2.26
Dec. 29 to Jan. 13,	4.00	4.00	–	9.25	–	15.00	–	–	–	–	17.44	1:5.50	1,050	1,060	0.67
Jan. 19 to Feb. 23,	4.00	4.00	–	–	–	–	32.87	–	–	–	13.85	1:5.24	1,085	1,100	0.43
March 1 to March 23,	4.00	4.00	–	–	–	–	–	65.01	–	–	17.46	1:5.99	1,120	1,170	2.27
March 29 to April 9,	4.00	4.00	–	–	–	–	–	–	11.45	–	16.40	1:5.70	1,140	1,140	0.00
April 26 to May 16,	4.00	–	4.00	10.00	–	–	–	–	–	15.00	18.48	1:5.83	1,202	1,225	1.15

	Pounds.
Live weight of animal at the beginning of the experiment,	925.00
Live weight of animal at the time of killing,	1,225.00
Live weight gained during the experiment,	300.00
Average gain in weight per day (entire experiment),	1.60
Highest average gain in live weight per day, IV. period,	2.27
Lowest average gain in live weight per day, V. period,	0.00

Steer No. 2.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.										Total Amount of Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Maize Feed.	Gluten Feed.	Hay.	Turnips.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.	Corn Stover.	Sugar Beets.					
1891-92.															
Nov. 10 to Dec. 22,	3.44	3.44	–	9.81	17.38	–	–	–	–	–	16.79	1:5.70	926	1,018	2.19
Dec. 29 to Jan. 13,	4.00	4.00	–	9.00	–	15.00	–	–	–	–	17.21	1:5.30	1,065	1,065	0.00
Jan. 19 to Feb. 23,	4.00	4.00	–	–	–	–	33.74	–	–	–	14.03	1:5.25	1,080	1,100	0.57
March 1 to March 23,	4.00	4.00	–	–	–	–	–	47.45	–	–	14.70	1:5.62	1,115	1,145	1.36
March 29 to April 9,	4.00	4.00	–	–	–	–	–	–	10.64	–	15.75	1:5.52	1,115	1,122	0.64
April 26 to May 16,	4.00	–	4.00	10.00	–	–	–	–	–	15.00	18.48	1·5.83	1,160	1,178	0.90

	Pounds.
Live weight of animal at the beginning of the experiment,	926.00
Live weight of animal at the time of killing,	1,178.00
Live weight gained during the experiment,	252.00
Average gain in weight per day (entire experiment),	1.34
Highest average gain in live weight per day, I. period,	2.19
Lowest average gain in live weight per day, II. period,	0.00

Steer No. 3.

Feeding Periods.	Feed consumed (Pounds) per Day.										Total Amount of Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Maize Feed.	Gluten Feed.	Hay.	Turnips.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.	Corn Stover.	Sugar Beets.					
1891-92.															
Nov. 10 to Dec. 22,	3.44	3.44	–	11.10	17.38	–	–	–	–	–	17.96	1 : 5.83	955	1,040	2.02
Dec. 29 to Jan. 13,	4.00	4.00	–	9.26	–	15.00	–	–	–	–	17.45	1 : 5.50	1,082	1,085	0.20
Jan. 19 to Feb. 23,	4.00	4.00	–	–	–	–	35.03	–	–	–	14.28	1 : 5.26	1,090	1,125	1.00
March 1 to March 23,	4.00	4.00	–	–	–	–	–	59.77	–	–	16.63	1 : 5.95	1,133	1,200	3.05
March 29 to April 9,	4.00	4.00	–	–	–	–	–	–	11.60	–	16.52	1 : 5.73	1,160	1,165	0.45
April 26 to May 16,	4.00	–	4.00	10.00	–	–	–	–	–	15.00	18.48	1 : 5.83	1,210	1,230	1.00

	Pounds.
Live weight of animal at the beginning of the experiment,	955.00
Live weight of animal at the time of killing,	1,230.00
Live weight gained during the experiment,	275.00
Average gain in weight per day (entire experiment),	1.46
Highest average gain in live weight per day, IV. period,	3.05
Lowest average gain in live weight per day, II. period,	0.20

III.

WINTER FEEDING EXPERIMENTS WITH LAMBS.

November, 1891, to May, 1892.

The experiment briefly described in a few succeeding pages is the third one of a series designed for the purpose of studying the feeding effect and general economy of different combinations of grain feed stuffs when fed in connection with the same or similar kinds of coarse fodder articles for the production of meat.

During our *first* experiment, corn meal, wheat bran and gluten meal (Chicago) furnished in varying proportions the grain feed part of the daily diet (see eighth annual report, pages 67–90). During the *second*, corn meal, wheat bran, old-process linseed meal and gluten meal (Chicago) served for that purpose (see ninth annual report, pages 128–147); while in the *third experiment*, which is here under discussion, *wheat bran*, *Buffalo gluten feed* and *Chicago maize feed* have been used as the grain feed part of the daily feed.

The coarse feed portion of the daily diet during the first and second experiments consisted exclusively of rowen (hay of the second cut of upland meadows) and of corn ensilage. In the third experiment during one feeding period corn ensilage was substituted by roots (globe mangolds). The selection of lambs in all these trials was confined to our local supply. From six to nine animals served in each case for our observations.

Six lambs, wethers, grades of uncertain parentage, were selected for the experiment here under consideration. Each animal occupied a separate pen during the entire time of observation; none of them were shorn before entering upon the trial.

1. *Live Weight and Cost of Lambs.*

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	Total.
Live weight (pounds), ...	74.00	68.50	67 25	73.50	65.00	77.75	426.00
Market cost at 5.5 cents per pound, .	$4 07	$3 77	$3 70	$4 04	$3 58	$4 28	$23 44

2. *Character and Cost of Fodder Articles.*

The grain feed used consisted of wheat bran, Chicago maize feed and Buffalo gluten feed bought in our local market. These articles were of a fair quality and of a good mechanical condition. *Chicago maize feed* and *Buffalo gluten feed* are waste products obtained from maize in connection with the manufacture of glucose-sugar; they are valuable recent additions to our commercial resources of concentrated feed stuffs. The coarse feed stuffs, consisting of rowen (hay of second cut of upland meadows), of corn ensilage and of globe mangolds, were produced at the station, and were of the same good quality as those described in a previous bulletin (No. 42). The local market value and the chemical composition of the various fodder articles used at different times in the daily diet are recorded in the subsequent tabular statements.

Local Market Cost per Ton of the Various Articles of Fodder used.

Wheat bran, ...	$22 00
Maize feed (Chicago), ...	25 00
Gluten feed (Buffalo), ...	23 00
Rowen, ...	15 00
Globe mangolds, ...	4 00
Dent corn ensilage, ...	2 50
Sweet corn ensilage, ...	2 50

Analyses of the Various Articles of Fodder used.

FOOD ANALYSES.	Wheat Bran.	Maize Feed.	Gluten Feed.	Rowen.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.
Moisture at 100° C.,	10.01	8.70	8.97	13.90	87.75	79.92	84.30
Dry matter,	89.99	91.30	91.03	86.10	12.25	20.08	15.70
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.							
Crude ash,	6.58	0.78	0.77	8.28	9.06	4.99	6.32
" cellulose,	11.77	7.97	5.09	28.88	7.94	27.19	29.32
" fat,	5.04	7.37	13.46	3.91	0.88	3.29	7.36
" protein,	18.06	27.55	26.16	13.45	10.37	8.29	7.86
Non-nitrogenous extract matter,	58.55	56.33	54.52	45.48	71.75	56.24	49.14
	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

FERTILIZER ANALYSES.	Wheat Bran.	Maize Feed.	Gluten Feed.	Rowen.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.
Moisture,	10.01	8.70	8.97	13.90	87.75	79.92	84.30
Nitrogen,	2.60	4.03	3.81	1.853	0.203	0.27	0.20
Phosphoric acid,	2.85	0.70	0.69	0.464	0.093	0.14	0.089
Potassium oxide,	1.63	0.43	0.42	1.966	0.383	0.33	0.41
Valuation per 2,000 pounds,	$12 40	$13 25	$12 57	$7 84	$1 06	$1 26	$1 06

3. *Mode of Feeding.*

The grain feed portion of the daily diet consisted in every instance of *equal weights* of either wheat bran and Chicago maize feed or of wheat bran and Buffalo gluten feed. The amount of each used per head in the daily fodder ration varied in different feeding periods somewhat; during the earlier stages of the experiment it amounted to five ounces of each, per head, during later periods to six ounces. All animals received the same quantity at the same stage of the observation.

The daily coarse feed rations consisted either of rowen hay or of rowen hay with either corn ensilage or roots (globe mangolds). Whenever corn ensilage or roots were fed in common with rowen hay, only one-half of the customary daily rowen ration was given, while the consumption of corn ensilage or of the roots was governed by the appetite of each animal. One-half of the daily fodder ration — fine and coarser feed — was fed in the morning and the other half later in the afternoon. Water was given once a day, a few hours after feeding (mornings).

The entire experiment extended over a period of one hundred and eighty-three days, and was subdivided into five distinct feeding periods, varying in length from fourteen to thirty-five days, with five days between the periods.

Average Composition of the Daily Fodder Rations used during the Six Successive Feeding Periods.

I.		II.	
November 17 to December 1.		*December 5 to January 13.*	
Wheat bran (pounds),	0.34	Wheat bran (pounds),	0.33
Maize feed (pounds),	0.34	Maize feed (pounds),	0.33
Rowen (pounds),	1.37	Rowen (pounds),	0.68
Nutritive ratio,	1:4.84	Globe mangolds (pounds),	2.97
Total cost (cents),	1.83	Nutritive ratio,	1:5.12
Manurial value obtainable (cents),	0.89	Total cost (cents),	1.88
Net cost (cents),	0.94	Manurial value obtainable (cents),	0.78
		Net cost (cents),	1.10

III.		IV.	
January 17 to February 22.		*February 26 to March 23.*	
Wheat bran (pounds),	0.35	Wheat bran (pounds),	0.38
Maize feed (pounds),	0.35	Maize feed (pounds),	0.38
Rowen (pounds),	0.77	Rowen (pounds),	0.84
Dent corn ensilage (pounds),	1.97	Sweet corn ensilage (pounds),	2.68
Nutritive ratio.	1:5.26	Nutritive ratio,	1:5.34
Total cost (cents),	1.65	Total cost (cents),	1.86
Manurial value obtainable (cents),	0.80	Manurial value obtainable (cents),	0.88
Net cost (cents),	0.85	Net cost (cents),	0.98

Average Composition, etc. — Concluded.

V.		VI.	
March 27 to April 23.		*April 27 to May 18.*	
Wheat bran (pounds),	0.40	Wheat bran (pounds),	0.40
Maize feed (pounds),	0.40	Gluten feed (pounds),	0.40
Rowen (pounds),	1.40	Rowen (pounds),	1.37
Nutritive ratio,	1:4.79	Nutritive ratio,	1:5.02
Total cost (cents),	1.99	Total cost (cents),	1.93
Manurial value obtainable (cents),	0.98	Manurial value obtainable (cents),	0.95
Net cost (cents),	1.01	Net cost (cents),	0.98

Summary of Cost of the Above-stated Average Daily Fodder Rations used.

[Cents.]

	Feeding Periods.					
	I.	II.	III.	IV.	V.	VI.
Total cost,	1.83	1.88	1.65	1.86	1.99	1.93
Manurial value obtainable,	0.89	0.78	0.80	0.88	0.98	0.95
Net cost,*	0.94	1.10	0.85	0.98	1.01	0.98

* Allowing ninety-two per cent. of the manurial value of the feed consumed obtainable.

4. *Gain in Live Weight during Experiment.*

[Pounds.]

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	Average.
Live weight at beginning of experiment,	74.00	68.50	67.25	73.50	65.00	77.75	71.00
Live weight at close of experiment,	97.00	85.50	87.50	85.00	75.00	98.50	88.08
Live weight gained during experiment,	23.00	17.00	20.25	11.50	10.00	20.75	17.07

The live weight of the lambs (six) engaged in our first experiment averaged, at the beginning of our experiments, 71 pounds; of those engaged in the second experiment (six) it averaged 53.5 pounds.

Yield of Dressed Weight.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	Total.
Pounds of dressed weight,	52.25	46.50	44.00	43.00	36.00	53.25	275.00
Returns at 11 cents per pouud,	$5 75	$5 11	$4 84	$4 73	$3 96	$5 86	$30 25

Yield of Wool.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	Total.
Pounds of wool,	6.50	5.25	5.75	5.25	6.25	5.75	34.75
Returns at 21 cents per pound,	$1 37	$1 10	$1 21	$1 10	$1 31	$1 21	$7 30

5. *Financial Results.*

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	Total.
Cost of lambs,	$4 11	$3 82	$3 75	$4 18	$3 73	$4 35	
Cost of feed consumed,	3 67	3 38	3 41	3 53	2 75	3 54	
	$7 78	$7 20	$7 16	$7 71	$6 48	$7 89	$44 22
Value received for meat,	$5 75	$5 11	$4 84	$4 73	$3 96	$5 86	
Value received for wool,	1 37	1 10	1 21	1 10	1 31	1 21	
Value of obtainable manure,	1 73	1 59	1 60	1 67	1 28	1 66	
	$8 85	$7 70	$7 65	$7 50	$6 55	$8 73	$47 08

Conclusions.

1. The average daily increase in live weight as compared with that noticed in the two preceding experiments is not as satisfactory; lambs 4 and 5 fall not less than fifty per cent. behind, when compared with the gain obtained in case of lambs 1, 3 and 6.

2. The feeding effect of corn ensilage, when fed with the same kind and amount of grain feed, compares well with that of globe mangold roots.

3. The market cost of the daily fodder rations above stated is in the majority of cases lower than that of those used in our preceding experiments with lambs; it varies from 1.65 cents to 1.93 cents in different feeding periods.

4. The manurial value obtainable from the different daily fodder rations varies from 0.78 to 0.98 cents; it amounts to one-half of the market cost of the daily diet.

5. The temporary ruling low market cost of the grain feed during the third experiment, as compared with those on preceding occasions, and the high commercial value of the obtainable manurial refuse, due to their rich nitrogenous composition, have secured still a small profit over expenses charged where the rate of producing meat was too low to entitle to profit. In considering the stated financial results in all our feeding experiments, thus far published, it ought to be kept in mind that all our home-raised fodder articles are charged at a liberal local market price per ton.

Sheep No. 1.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.							Total Amount of Dry Matter consumed per Day (Pounds).	Gain in Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Wheat Bran.	Maize Feed.	Gluten Feed.	Rowen.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.					
1891-92.												
Nov. 17 to Dec. 1,	0.34	0.34	–	1.35	–	–	–	1.78	0.07	25.43	1:4.84	74.58
Dec. 5 to Jan. 13,	0.33	0.33	–	0.68	3.00	–	–	1.55	0.28	5.54	1:5.12	78.87
Jan. 17 to Feb. 22,	0.37	0.37	–	0.86	–	1.94	–	1.80	0.18	10.00	1:5.26	89.92
Feb. 26 to March 23,	0.48	0.48	–	1.00	–	–	3.42	2.27	0.21	10.81	1:5.34	96.20
March 27 to April 23,	0.50	0.50	–	1.35	–	–	–	2.07	0.13	15.92	1:4.78	98.38
April 27 to May 18,	0.50	–	0.50	1.31	–	–	–	2.03	–0.29	–	1:5.00	100.37

Total Amount of Feed consumed from Nov. 17, 1891, to May 18, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
75.25 pounds wheat bran, ...	67.62	$0 83	$0 47
63.25 pounds maize feed, ...	57.75	0 79	0 42
12.00 pounds gluten feed, ...	10.92	0 14	0 08
189.50 pounds rowen, ...	163.15	1 42	0 74
128.00 pounds globe mangolds, . . .	15.68	0 26	0 07
82.00 pounds dent corn ensilage, . .	16.47	0 10	0 05
101.00 pounds sweet corn ensilage,. .	15.87	0 13	0 05
	347.46	$3 67	$1 88

	Pounds.
Live weight of animal at the beginning of the experiment, .	74.00
Live weight of animal at the time of killing, ...	97.00
Live weight gained during the experiment, ...	23.00
Average gain in weight per day (entire experiment), . . .	0.126
Dressed weight of animal, ...	52.25
Loss in weight by dressing, 46.13 per cent., or	44.75

Pounds of dry matter fed produced 1 pound of live weight, 15.11.

Cost of feed per pound of live weight gained, 15.96 cents.

Net cost of feed per pound gained after deducting 8 per cent. of manurial value, 8.43 cents.

Sheep No. 2.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.							Total Amount of Dry Matter consumed per Day (Pounds).	Gain in Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Wheat Bran.	Maize Feed.	Gluten Feed.	Rowen.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.					
1891-92.												
Nov. 17 to Dec. 1,	0.34	0.34	–	1.35	–	–	–	1.78	0.21	8.48	1:4.84	70.33
Dec. 5 to Jan. 13,	0.33	0.33	–	0.63	2.79	–	–	1.48	0.18	8.22	1:5.10	73.17
Jan. 17 to Feb. 22,	0.37	0.37	–	0.89	–	1.85	–	1.81	0.14	12.95	1:5.26	82.67
Feb. 26 to March 23,	0.37	0.37	–	0.85	–	–	2.00	1.71	0.13	13.15	1:5.33	85.56
March 27 to April 23,	0.37	0.37	–	1.46	–	–	–	1.93	0.13	14.85	1:4.79	88.50
April 27 to May 18,	0.37	–	0.37	1.45	–	–	–	1.92	-0.25	–	1:5.04	89.31

Total Amount of Feed consumed from Nov. 17, 1891, to May 18, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
65.62 pounds wheat bran, ...	59.05	$0 72	$0 41
56.62 pounds maize feed, ...	51.69	0 71	0 37
9.00 pounds gluten feed, ...	8.19	0 10	0 06
190.50 pounds rowen, ...	164.02	1 43	0 75
120.00 pounds globe mangolds, . .	14.70	0 24	0 06
78.50 pounds dent corn ensilage, . .	15.76	0 10	0 05
65.00 pounds sweet corn ensilage, . .	10.21	0 08	0 03
	323.62	$3 38	$1 73

	Pounds.
Live weight of animal at the beginning of the experiment, .	68.50
Live weight of animal at the time of killing, ...	85.50
Live weight gained during the experiment, ...	17.00
Average gain in weight per day (entire experiment), . .	0.093
Dressed weight of animal, ...	46.50
Loss in weight by dressing, 45.61 per cent., or	39.00

Pounds of dry matter fed produced 1 pound of live weight, 19.04.

Cost of feed per pound of live weight gained, 19.88 cents.

Net eost of feed per pound gained after deducting 8 per cent. of manurial value, 10.53 cents.

Sheep No. 3.

Feeding Periods.	Feed consumed (Pounds) per Day.							Total Amount of Dry Matter consumed per Day (Pounds).	Gain in Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Wheat Bran.	Maize Feed.	Gluten Feed.	Rowen.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.					
1891-92.												
Nov. 17 to Dec. 1,	0.31	0.31	–	1.25	–	–	–	1.64	0.23	7.13	1:4.84	69.25
Dec. 5 to Jan. 13,	0.37	0.37	–	0.83	3.00	–	–	1.75	0.22	7.95	1:5.12	74.42
Jan. 17 to Feb. 22,	0.37	0.37	–	0.81	–	1.51	–	1.67	0.10	16.70	1:5.25	80.90
Feb. 26 to March 23,	0.37	0.37	–	0.94	–	–	1.96	1.79	0.08	22.38	1:5.33	84.12
March 27 to April 23,	0.37	0.37	–	1.39	–	–	–	1.87	0.03	62.33	1:4.78	86.87
April 27 to May 18,	0.37	–	0.37	1.21	–	–	–	1.71	0.13	13.15	1:5.02	87.81

Total Amount of Feed consumed from Nov. 17, 1891, to May 18, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
67.00 pounds wheat bran, ...	60.29	$0 74	$0 42
58.00 pounds maize feed, ...	52.95	0 73	0 38
9.00 pounds gluten feed, ...	8.19	0 10	0 06
189.50 pounds rowen, ...	163.15	1 42	0 74
128.00 pounds globe mangolds, . .	15.68	0 26	0 07
66.50 pounds dent corn ensilage, . .	13.35	0 08	0 04
63.00 pounds sweet corn ensilage, . .	9.89	0 08	0 03
	323.50	$3 41	$1 74

	Pounds.
Live weight of animal at the beginning of the experiment, .	67.25
Live weight of animal at the time of killing, ...	87.50
Live weight gained during the experiment, ...	20.25
Average gain in weight per day (entire experiment), . .	0.110
Dressed weight of animal, ...	44.00
Loss in weight by dressing, 49.71 per cent., or	43.50

Pounds of dry matter fed produced 1 pound of live weight, 15.97.

Cost of feed per pound of live weight gained, 16.84 cents.

Net cost of feed per pound gained after deducting 8 per cent. of manurial value, 8.93.

Sheep No. 4.

Feeding Periods.	Feed consumed (Pounds) per Day.							Total Amount of Dry Matter consumed per Day (Pounds).	Gain in Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Wheat Bran.	Maize Feed.	Gluten Feed.	Rowen.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.					
1891-92.												
Nov. 17 to Dec. 1,	0.33	0.33	-	1.32	-	-	-	1.73	0.11	15.73	1:4.84	74.08
Dec. 5 to Jan. 13,	0.37	0.37	-	0.80	3.00	-	-	1.72	0.18	9.56	1:5.12	79.33
Jan. 17 to Feb. 22,	0.37	0.37	-	1.00	-	2.00	-	1.93	0.05	38.60	1:5.26	84.70
Feb. 26 to March 23,	0.37	0.37	-	1.00	-	-	2.61	1.94	0.13	14.92	1:5.36	86.75
March 27 to April 23,	0.37	0.37	-	1.39	-	-	-	1.87	0.06	31.17	1:4.78	89.87
April 27 to May 18,	0.37	-	0.37	1.43	-	-	-	1.90	-0.22	-	1:5.04	89.19

Total Amount of Feed consumed from Nov. 17, 1891, to May 18, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
67.50 pounds wheat bran,	60.74	$0 74	$0 42
58.50 pounds maize feed,	53.41	0 73	0 39
9.00 pounds gluten feed,	8.19	0 10	0 06
198.50 pounds rowen,	160.91	1 49	0 78
128.00 pounds globe mangolds,	15.68	0 26	0 07
84.00 pounds dent corn ensilage,	16.87	0 11	0 05
80.00 pounds sweet corn ensilage,	12.56	0 10	0 04
	328.36	$3 53	$1 81

	Pounds.
Live weight of animal at the beginning of the experiment,	73.50
Live weight of animal at the time of killing,	85.00
Live weight gained during the experiment,	11.50
Average gain in weight per day (entire experiment),	0.063
Dressed weight of animal,	43.00
Loss in weight by dressing, 49.41 per cent., or	42.00

Pounds of dry matter fed produced 1 pound of live weight, 28.55.

Cost of feed per pound of live weight gained, 30.70 cents.

Net cost of feed per pound gained after deducting 8 per cent. of manurial value, 16.17 cents.

Sheep No. 5.

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.							Total Amount of Dry Matter consumed per Day (Pounds).	Gain in Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Wheat Bran.	Maize Feed.	Gluten Feed.	Rowen.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.					
1891-92.												
Nov. 17 to Dec. 1,	0.31	0.31	–	1.23	–	–	–	1.62	0.02	81.00	1:4.84	64.67
Dec. 5 to Jan. 13,	0.27	0.27	–	0.33	3.00	–	–	1.11	0.15	7.60	1:5.12	68.79
Jan. 17 to Feb. 22,	0.25	0.25	–	0.39	–	2.00	–	1.19	0.06	19.83	1:5.21	73.95
Feb. 26 to March 23,	0.26	0.26	–	0.56	–	–	2.42	1.33	0.01	33.25	1:5.30	76.37
March 27 to April 23,	0.31	0.31	–	1.41	–	–	–	1.80	–0.20	–	1:4.85	76.62
April 27 to May 18,	0.31	–	0.31	1.48	–	–	–	1.84	0.39	4.72	1:5.10	74.17

Total Amount of Feed consumed from Nov. 17, 1891, to May 18, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
51.50 pounds wheat bran,	46.34	$0 57	$0 32
44.00 pounds maize feed,	40.17	0 55	0 29
7.50 pounds gluten feed,	6.83	0 09	0 05
144.25 pounds rowen,	124.20	1 08	0 57
128.00 pounds globe mangolds,	15.68	0 26	0 07
84.50 pounds dent corn ensilage,	16.97	0 11	0 05
75.00 pounds sweet corn ensilage,	11.78	0 09	0 04
	261.97	$2 75	$1 39

	Pounds.
Live weight of animal at the beginning of the experiment,	65.00
Live weight of animal at the time of killing,	75.00
Live weight gained during the experiment,	10.00
Average gain in weight per day (entire experiment),	0.054
Dressed weight of animal,	36.00
Loss in weight by dressing, 52.00 per cent., or	39.00

Pounds of dry matter fed produced 1 pound of live weight, 26.20.

Cost of feed per pound of live weight gained, 27.50 cents.

Net cost of feed per pound gained after deducting 8 per cent. of manurial value, 14.70 cents.

Sheep No. 6.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.							Total Amount of Dry Matter consumed per Day (Pounds).	Gain in Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Wheat Bran.	Maize Feed.	Gluten Feed.	Rowen.	Globe Mangolds.	Dent Corn Ensilage.	Sweet Corn Ensilage.					
1891-92.												
Nov. 17 to Dec. 1,	0.42	0.42	–	1.70	–	–	–	2.22	0.16	13.88	1:4.84	79.33
Dec. 5 to Jan. 13,	0.32	0.32	–	0.79	3.00	–	–	1.63	0.16	10.19	1:5.14	83.12
Jan. 17 to Feb. 22,	0.35	0.35	–	0.64	–	2.51	–	1.69	0.10	16.90	1:5.27	91.35
Feb. 26 to March 23,	0.40	0.40	–	0.69	–	–	3.69	1.90	0.17	11.18	1:5.38	97.19
March 27 to April 23,	0.50	0.50	–	1.39	–	–	–	2.10	0.23	9.13	1:4.78	101.62
April 27 to May 18,	0.50	–	0.50	1.36	–	–	–	2.07	–0.34	–	1:5.00	103.50

Total Amount of Feed consumed from Nov. 17, 1891, to May 18, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
73.12 pounds wheat bran, ...	65.79	$0 80	$0 45
61.12 pounds maize feed, ...	55.80	0 76	0 40
12.00 pounds gluten feed, ...	10.92	0 14	0 08
174.50 pounds rowen, ...	150.24	1 31	0 68
128.00 pounds globe mangolds, . .	15.68	0 26	0 07
102.50 pounds dent corn ensilage, . .	20.58	0 13	0 06
108.00 pounds sweet corn ensilage, . .	16.96	0 14	0 06
	335.97	$3 54	$1 80

	Pounds.
Live weight of animal at the beginning of the experiment, .	77.75
Live weight of animal at the time of killing, ...	98.50
Live weight gained during the experiment, ...	20.75
Average gain in weight per day (entire experiment), . .	0.113
Dressed weight of animal, ...	53.25
Loss in weight by dressing, 45.94 per cent., or	45.25

Pounds of dry matter fed produced 1 pound live weight, 16.19.

Cost of feed per pound of live weight gained, 17.06 cents.

Net cost of feed per pound gained after deducting 8 per cent. of manurial value, 9.06 cents.

IV.

FEEDING EXPERIMENTS WITH PIGS (TWO).

1891–92.

Introduction. — The results of fifteen different feeding experiments with young pigs, grades and thoroughbreds, for the meat market, have already been published in our preceding annual reports. The results of two new experiments are reported on the present occasion.

We usually keep, the whole year around, one young pig for every cow in the dairy, to dispose of our skim-milk. On the average, five lots of young pigs are prepared for the meat market every two years. The animals are usually bought when from five to six weeks old, and weigh from 25 to 30 pounds per head. They are fed until they reach a live weight of from 180 to 190 pounds, when they are sold to the butcher.

From 112 to 125 days are usually required to produce the desired live weight. Their daily gain in live weight has been from 1.4 to 1.5 pounds. During spring, summer and autumn one to two weeks less time is needed than during the winter season to finish the operation. The shrinkage from live weight to dressed weight varies usually from 18 to 21 per cent.

Our daily supply of skim-milk rarely exceeds five quarts per head of young pigs. We usually begin feeding from two to three ounces of corn meal with every quart of skim-milk required at the time. As soon as the live weight has reached from 60 to 70 pounds per head we increase the corn meal to four ounces per quart of skim-milk consumed.

The additional feed subsequently called for has usually been made of either a suitable mixture of several kinds of commercial feed stuffs, as wheat bran and Chicago gluten meal, or dried brewers' grain and gluten meal, or ground

barley and Chicago maize feed; or some single feed stuff, as Buffalo gluten feed or Chicago maize feed. The market cost of the various feed stuffs suitable for the purpose largely controls, for obvious reasons, their temporary selection.

During the present year (1892) Chicago maize feed and Buffalo gluten feed have been chosen for our observation. The market cost of the feed consumed per pound of dressed pork produced has varied during past years from 4.3 to 6.4 cents.

The available manurial refuse has amounted to two-fifths of the market cost of the feed consumed. Dressed pork has of late sold at from $6\frac{1}{2}$ to $7\frac{1}{2}$ cents per pound. Allowing 20 per cent. of shrinkage —

7.25 cents per pound of dressed weight is equal to 5.8 cents per pound live weight.
6.50 cents per pound of dressed weight is equal to 5.2 cents per pound live weight.
6.00 cents per pound of dressed weight is equal to 4.8 cents per pound live weight.

Sixteenth Feeding Experiment with Pigs.

September, 1891, to February, 1892.

Six pigs, grade Chester Whites, were purchased on Sept. 12, 1891, at $2.50 apiece. Three were sows and three barrows. For a period of about nine weeks preceding the experiment proper the pigs were fed on skim-milk and potatoes. The potatoes were boiled and mashed with the milk. The figures below are for the entire six pigs, no individual records having been kept of this period.

Total Amount of Feed consumed from Sept. 22, 1891, to Nov. 28, 1891.

	Cost.	Manurial Value.
1,875.00 quarts skim-milk, ...	$8 44	$3 97
1,752.00 pounds potatoes, ...	5 25*	0 84
	$13 69	$4 81

* At 15 cents per bushel, small, and not suitable for family use.

	Pounds.
Total live weight of the six pigs September 22,	244.00
Total live weight of the six pigs November 28,	520.50
Total live weight gained,	276.50
Average gain in weight per day (entire period),	4.13
Average daily gain per pig,	0.69

Total cost of feed per pound of live weight gained, 4.95 cents.

Net cost of feed per pound gained after deducting 30 per cent. of manurial value, 3.73 cents.

Local Market Cost of the Various Articles of Fodder used.

Barley meal, per ton,	$30 00
Skim-milk, per gallon,	0 018
Wheat bran, per ton,	22 00
Maize feed (Chicago), per ton,	25 00

Analyses of the Various Articles of Fodder used.

Food Analyses.	Barley Meal.	Skim-milk.	Wheat Bran.	Maize Feed.
Moisture at 100° C.,	12.90	89.78	10.01	8.70
Dry matter,	87.10	10.22	89.99	91.30
	100.00	100.00	100.00	100.00
Analysis of Dry Matter.				
Crude ash,	2.30	6.85	6.58	0.78
" cellulose,	7.11	–	11.77	7.97
" fat,	1.94	3.82	5.04	7.37
" protein,	10.80	31.60	18.06	27.55
Non-nitrogenous extract matter,	77.85	57.73	58.55	56.33
	100.00	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

Fertilizer Analyses.	Barley Meal.	Skim-milk.*	Wheat Bran.	Maize Feed.
Moisture,	12.90	89.78	10.01	8.70
Nitrogen,	1.507	0.52	2.60	4.03
Phosphoric acid,	0.664	0.19	2.85	0.70
Potassium oxide,	0.342	0.20	1.63	0.43
Valuation per 2,000 pounds,	$5 56	$1 95	$12 40	$13 25

* One quart equals 2.17 pounds.

Conclusions.

1. The entire lot of young pigs (six), weighing on an average 40 pounds per head, gained in 69 days, when fed in one pen together on boiled potatoes and skim-milk (one pound of potatoes to every quart of milk consumed), 46 pounds in live weight per head, or 0.69 pounds per day, at an average cost of 4.95 cents per pound of live weight gained.

2. The same lot of pigs, when subsequently isolated in six different pens and fed on a daily diet consisting, as previously specified, of skim-milk, barley meal, wheat bran and Chicago maize feed, gained on an average in 65 days 95.5 pounds each, or 1.49 pounds per day, at an average total cost of 5.64 cents per pound of live weight, or 4.8 cents of net cost.

3. The high cost of feed per pound of live weight gained in this experiment is due to two causes, namely, low rate of daily increase in live weight during the first half of the time occupied by the experiment, and to the high market cost of the ground barley used in large quantities during the second half of the experiment.

Pig No. 1.

Feeding Period.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Maize Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1891-92. Dec. 1 to Feb. 3,	169.37	344.00	77.06	77.06	1:4.07	71.00	171.00	1.56

Total Amount of Feed consumed from Dec. 1, 1891, to Feb. 3, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
169.37 pounds barley meal,	147.52	$2 54	$0 47
344.00 quarts skim-milk,	76.29	1 55	0 73
77.06 pounds wheat bran,	69.35	0 85	0 48
77.06 pounds maize feed,	70.36	0 96	0 51
	363.52	$5 90	$2 19

	Pounds.
Live weight of animal at the beginning of the experiment,	71.00
Live weight of animal at the time of killing,	171.00
Live weight gained during the experiment,	100.00
Dressed weight of animal,	131.50
Loss in weight by dressing, 23.10 per cent., or	39.50
Dressed weight gained during the experiment,	76.90

Pounds of dry matter fed produced 1 pound of live weight, 3.64.

Pounds of dry matter fed produced 1 pound of dressed weight, 4.73.

Cost of feed per pound of dressed weight gained, 7.67 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of the manurial value, 5.69 cents.

Pig No. 2.

Feeding Period.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Maize Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1891-92. Dec. 1 to Feb. 3,	172.00	344.00	94.03	94.03	1:4.03	94.00	194.00	1.56

Total Amount of Feed consumed from Dec. 1, 1891, to Feb. 3, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
172.00 pounds barley meal,	149.81	$2 58	$0 48
344.00 quarts skim-milk,	76.29	1 55	0 73
94.03 pounds wheat bran,	84.62	1 03	0 58
94.03 pounds maize feed,	85.85	1 18	0 62
	396.57	$6 34	$2 41

	Pounds.
Live weight of animal at the beginning of the experiment,	94.00
Live weight of animal at the time of killing,	194.00
Live weight gained during the experiment,	100.00
Dressed weight of animal,	149.00
Loss in weight by dressing, 23.20 per cent., or	45.00
Dressed weight gained during the experiment,	76.80

Pounds of dry matter fed produced 1 pound of live weight, 3.97.

Pounds of dry matter fed produced 1 pound of dressed weight, 5.16.

Cost of feed per pound of dressed weight gained, 8.25 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of the manurial value, 6.05 cents.

Pig No. 3.

Feeding Period.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Maize Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1891-92. Dec. 1 to Feb. 3, . .	172.00	344.00	90.66	90.66	1:4.06	99.50	192.50	1.45

Total Amount of Feed consumed from Dec. 1, 1891, to Feb. 3, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
172.00 pounds barley meal, . .	149.81	$2 58	$0 48
344.00 quarts skim-milk, . . .	76.29	1 55	0 73
90.66 pounds wheat bran, . .	81.58	1 00	0 56
90.66 pounds maize feed, . .	82.77	1 13	0 60
	390.45	$6 26	$2 37

	Pounds.
Live weight of animal at the beginning of the experiment, .	99.50
Live weight of animal at the time of killing, ...	192.50
Live weight gained during the experiment, ...	93.00
Dressed weight of animal, ...	146.50
Loss in weight by dressing, 23.90 per cent., or	46.00
Dressed weight gained during the experiment, ...	70.77

Pounds of dry matter fed produced 1 pound of live weight, 4.20.

Pounds of dry matter fed produced 1 pound of dressed weight, 5.52.

Cost of feed per pound of dressed weight gained, 8.84 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of the manurial value, 6.50 cents.

Pig No. 4.

Feeding Period.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Maize Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1891-92. Dec. 1 to Feb. 3,	172.00	344.00	80.34	80.34	1:4.08	92.75	185.00	1.44

Total Amount of Feed consumed from Dec. 1, 1891, to Feb. 3, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
172.00 pounds barley meal,	149.81	$2 58	$0 48
344.00 quarts skim-milk,	76.29	1 55	0 73
80.34 pounds wheat bran,	72.30	0 88	0 50
80.34 pounds maize feed,	73.35	1 00	0 53
	371.75	$6 01	$2 24

	Pounds.
Live weight of animal at the beginning of the experiment,	92.75
Live weight of animal at the time of killing,	185.00
Live weight gained during the experiment,	92.25
Dressed weight of animal,	151.00
Loss in weight by dressing, 18.38 per cent., or	34.00
Dressed weight gained during the experiment,	75.29

Pounds of dry matter fed produced 1 pound of live weight, 4.03.

Pounds of dry matter fed produced 1 pound of dressed weight, 4.94.

Cost of feed per pound of dressed weight gained, 7.98 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of the manurial value, 5.90 cents.

Pig No. 5.

Feeding Period.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Maize Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1891-92.								
Dec. 1 to Feb. 3, . .	172.00	344.00	90.47	90.47	1:4.06	92.50	192.00	1.55

Total Amount of Feed consumed from Dec. 1, 1891, to Feb. 3, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
172.00 pounds barley meal, . .	149.81	$2 58	$0 48
344.00 quarts skim-milk, . . .	76.29	1 55	0 73
90.47 pounds wheat bran, . .	81.41	1 00	0 56
90.47 pounds maize feed, . .	82.60	1 13	0 60
	390.11	$6 26	$2 37

	Pounds.
Live weight of animal at the beginning of the experiment, .	92.50
Live weight of animal at the time of killing, ...	192.00
Live weight gained during the experiment, ...	99.50
Dressed weight of animal, ...	142.00
Loss in weight by dressing, 26.04 per cent., or	50.00
Dressed weight gained during the experiment, ...	73.59

Pounds of dry matter fed produced 1 pound of live weight, 3.92.

Pounds of dry matter fed produced 1 pound of dressed weight, 5.30.

Cost of feed per pound of dressed weight gained, 8.51 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of the manurial value, 6.25 cents.

Pig No. 6.

Feeding Period.	Total Amount of Barley Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Maize Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1891-92. Dec. 1 to Feb. 3, . .	172.00	344.00	82.59	82.59	1:4.08	91.50	180.00	1.38

Total Amount of Feed consumed from Dec. 1, 1891, to Feb. 3, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
172.00 pounds barley meal, . .	149.80	$2 58	$0 48
344.00 quarts skim-milk, . . .	76.29	1 55	0 73
82.59 pounds wheat bran, . .	74.32	0 91	0 51
82.59 pounds maize feed, . .	75.40	1 03	0 55
	375.81	$6 07	$2 27

	Pounds.
Live weight of animal at the beginning of the experiment, .	91.50
Live weight of animal at the time of killing, ...	180.00
Live weight gained during the experiment, ...	88.50
Dressed weight of animal, ...	147.00
Loss in weight by dressing, 18.33 per cent., or	33.00
Dressed weight gained during the experiment, ...	72.28

Pounds of dry matter fed produced 1 pound of live weight, 4.25.

Pounds of dry matter fed produced 1 pound of dressed weight, 5.20.

Cost of feed per pound of dressed weight gained, 8.40 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of the manurial value, 6.20 cents.

Seventeenth Feeding Experiment with Pigs.

March, 1892, to July, 1892.

Six pigs, grade Chester Whites, were purchased on Feb. 23, 1892, at $3.00 a piece. No. 2 and No. 3 were barrows and the rest were sows.

Local Market Cost of the Various Articles of Fodder used.

Corn meal, per ton,	$24 00
Skim-milk, per gallon,	0 018
Gluten feed (Buffalo), per ton,	23 00

The mode of feeding, as well as the general management of the experiment, has been the same as on previous occasions of a corresponding character.

Analyses of the Various Articles of Fodder used.

Food Analyses.	Corn Meal.	Skim-milk.	Gluten Feed.
Moisture at 100° C.,	13.96	89.78	8.97
Dry matter,	86.04	10.22	91.03
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	1.26	6.85	0.77
" cellulose,	1.49	–	5.09
" fat,	3.97	3.82	13.46
" protein,	11.11	31.60	26.16
Non-nitrogenous extract matter,	82.17	57.73	54.52
	100.00	100.00	100.00

Fertilizing Constituents.

[Nitrogen 15 cents, phosphoric acid 5½ cents, potassium oxide 4½ cents, per pound.]

Fertilizer Analyses.	Corn Meal.	Skim-milk.*	Gluten Feed.
Moisture,	13.96	89.78	8.97
Nitrogen,	1.529	0.52	3.81
Phosphoric acid,	0.707	0.19	0.69
Potassium oxide,	0.435	0.20	0.42
Valuation per 2,000 pounds,	$5 76	$1 95	$12 57

* One quart equals 2.17 pounds.

Conclusions.

1. The average weight of the young pigs at the beginning of the experiment was 33 pounds per head, and their average weight at the close of the experiment was 191 pounds per head.

2. The experiment extended over 122 days. The daily gain in live weight averaged per head 1.56 pounds.

3. The total cost of feed eonsumed per pound of dressed weight produced averaged 5.8 cents, while the net cost averaged 4.2 cents. The obtainable manurial refuse amounted to two-fifths of the market cost of the diet consumed.

4. The dressed pork sold in our local markets at 6½ cents per pound.

Pig No. 1.

Feeding Periods.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim milk consumed (Quarts).	Total Amount of Gluten Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892.							
March 23 to May 10,	34.12	273.00	–	1:3.10	35.00	71.50	0.76
May 10 to June 21,	63.00	252.00	54.37	1:3.88	71.50	130.50	1.40
June 21 to July 28,	119.81	222.00	36.56	1:4.69	130.50	184.50	1.46

Total Amount of Feed consumed from March 23, 1892, to July 28, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
216.93 pounds corn meal,	186.65	$2 60	$0 62
747.00 quarts skim-milk,	76.34	3 36	1 58
90.93 pounds gluten feed,	82.77	1 05	0 57
	345.76	$7 01	$2 77

	Pounds.
Live weight of animal at the beginning of the experiment,	35.00
Live weight of animal at the time of killing,	184.50
Live weight gained during the experiment,	149.50
Dressed weight of animal,	154.00
Loss in weight by dressing, 16.53 per cent., or	30.50
Dressed weight gained during the experiment,	124.79

Pounds of dry matter fed produced 1 pound of live weight, 2.31.

Pounds of dry matter fed produced 1 pound of dressed weight, 2.77.

Cost of feed per pound of dressed weight gained, 5.62 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of manurial value, 4.06 cents.

Pig No. 2.

Feeding Periods.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Gluten Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892.							
March 23 to May 10, . . .	34.12	273.00	-	1:3.10	33.00	72.50	0.82
May 10 to June 21, . . .	63.00	252.00	55.12	1:3.88	72.50	133.50	1.45
June 21 to July 28, . . .	128.44	222.00	45.19	1:4.75	133.50	197.00	1.72

Total Amount of Feed consumed from March 23, 1892, to July 28, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
225.56 pounds corn meal, . . .	194.07	$2 71	$0 65
747.00 quarts skim-milk, . . .	76.34	3 36	1 58
100.31 pounds gluten feed, . .	91.31	1 15	0 63
	361.72	$7 22	$2 86

	Pounds.
Live weight of animal at the beginning of the experiment, .	33.00
Live weight of animal at the time of killing, ...	197.00
Live weight gained during the experiment, ...	164.00
Dressed weight of animal, ...	144.00
Loss in weight by dressing, 26.90 per cent., or	53.00
Dressed weight gained during the experiment, ...	119.88

Pounds of dry matter fed produced 1 pound of live weight, 2.21.

Pounds of dry matter fed produced 1 pound of dressed weight, 3.02.

Cost of feed per pound of dressed weight gained, 6.02 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of manurial value, 4.35 cents.

Pig No. 3.

Feeding Periods.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Gluten Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892.							
March 23 to May 10, . . .	34.12	273.00	-	1:3.10	34.50	71.50	0.77
May 10 to June 21, . . .	63.00	252.00	52.87	1:3.88	71.50	125.50	1.29
June 21 to July 28, . . .	128.37	222.00	45.12	1:4.75	125.50	196.50	1.91

Total Amount of Feed consumed from March 23, 1892, to July 28, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
229.47 pounds corn meal, . . .	197.44	$2 75	$0 66
747.00 quarts skim-milk, . . .	76.34	3 36	1 58
97.99 pounds gluten feed, . .	89.20	1 12	0 61
	362.98	$7 23	$2 85

	Pounds.
Live weight of animal at the beginning of the experiment, .	34.50
Live weight of animal at the time of killing, ...	196.00
Live weight gained during the experiment, ...	161.50
Dressed weight of animal, ...	148.00
Loss in weight by dressing, 24.49 per cent., or	48.00
Dressed weight gained during the experiment, ...	121.95

Pounds of dry matter fed produced 1 pound of live weight, 2.25.

Pounds of dry matter fed produced 1 pound of dressed weight, 2.98.

Cost of feed per pound of dressed weight gained, 5.93 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of manurial value, 4.29 cents.

Pig No. 4.

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim milk consumed (Quarts).	Total Amount of Gluten Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892.							
March 23 to May 10, ...	34.12	273.00	-	1:3.10	33.00	73.75	0.85
May 10 to June 21, ...	63.00	252.00	55.12	1:3.88	73.75	133.50	1.42
June 21 to July 28, ...	122.62	222.00	39.37	1:4.72	133.50	192.50	1.59

Total Amount of Feed consumed from March 23, 1892, to July 28, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
219.74 pounds corn meal, ...	189.06	$2 64	$0 63
747.00 quarts skim-milk, ...	76.34	3 36	1 58
94.49 pounds gluten meal, . . .	86.01	1 08	0 59
	351.41	$7 08	$2 80

	Pounds.
Live weight of animal at the beginning of the experiment, .	33.00
Live weight of animal at the time of killing, ...	192.50
Live weight gained during the experiment, ...	159.50
Dressed weight of animal, ...	148.00
Loss in weight by dressing, 23.12 per cent., or	44.50
Dressed weight gained during the experiment, ...	122.62

Pounds of dry matter fed produced 1 pound of live weight, 2.20.

Pounds of dry matter fed produced 1 pound of dressed weight, 2.87.

Cost of feed per pound of dressed weight gained, 5.77 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of manurial value, 4.18 cents.

Pig No. 5.

Feeding Periods.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim milk consumed (Quarts).	Total Amount of Gluten Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892.							
March 23 to May 10, . . .	34.12	273.00	–	1:3.10	30.00	70.25	0.84
May 10 to June 21, . . .	63.00	252.00	39.37	1:3.88	70.25	120.00	1.18
June 21 to July 28, . . .	124.62	222.00	41.37	1:4.73	120.00	183.25	1.71

Total Amount of Feed consumed from March 23, 1892, to July 28, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
221.74 pounds corn meal, . .	190.79	$2 66	$0 64
747.00 quarts skim-milk, . . .	76.34	3 36	1 58
80.74 pounds gluten meal, . .	73.50	0 93	0 51
	340.63	$6 95	$2 73

	Pounds.
Live weight of animal at the beginning of the experiment, .	30.00
Live weight of animal at the time of killing, ...	183.25
Live weight gained during the experiment, ...	153.25
Dressed weight of animal, ...	144.00
Loss in weight by dressing, 21.42 per cent., or	39.25
Dressed weight gained during the experiment, ...	120.42

Pounds of dry matter fed produced 1 pound of live weight, 2.22.

Pounds of dry matter fed produced 1 pound of dressed weight, 2.91.

Cost of feed per pound of dressed weight gained, 5.77 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of manurial value, 4.18 cents.

Pig No. 6.

Feeding Periods.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Gluten Feed consumed (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
1892.							
March 23 to May 10, . . .	34.12	273.00	-	1:3.10	35.00	79.50	0.93
May 10 to June 21, . . .	63.00	252.00	43.50	1:3.88	79.50	143.50	1.52
June 21 to July 28, . . .	131.81	222.00	48.56	1:4.45	143.50	200.75	1.55

Total Amount of Feed consumed from March 23, 1892, to July 28, 1892.

	Dry Matter (Pounds).	Cost.	Manurial Value.
228.93 pounds corn meal, . . .	196.97	$2 75	$0 66
747.00 quarts skim-milk, . . .	76.34	3 36	1 58
92.06 pounds gluten feed, . .	83.80	1 06	0 58
	357.11	$7 17	$2 82

	Pounds.
Live weight of animal at the beginning of the experiment, .	35.00
Live weight of animal at the time of killing, ...	200.75
Live weight gained during the experiment, ...	165.75
Dressed weight of animal, ...	157.00
Loss in weight by dressing, 21.79 per cent., or	43.75
Dressed weight gained during the experiment, ...	129.63

Pounds of dry matter fed produced 1 pound of live weight, 2.15.

Pounds of dry matter fed produced 1 pound of dressed weight, 2.75.

Cost of feed per pound of dressed weight gained, 5.53 cents.

Net cost of feed per pound of dressed weight gained after deducting 30 per cent. of manurial value, 4.01 cents.

V.

COMPILATION OF THE AMOUNT OF DIGESTIBLE NUTRIENTS CONSUMED DAILY IN THE DIFFERENT FEEDING EXPERIMENTS MADE AT THE MASSACHUSETTS STATE EXPERIMENT STATION (COMPILED BY DR. J. B. LINDSEY).

1886–92.

MILCH COWS — STEERS — LAMBS.

1. *Milch Cows.*

Number of Cows.	KIND OF FEED.	Total Dry Matter (Pounds).	DIGESTIBLE MATTER CONSUMED DAILY PER 1,000 POUNDS LIVE WEIGHT.				Nutritive Ratio.
			Organic Matter (Pounds).	Protein (Pounds).	Carbohydrates (Pounds).	Fat (Pounds).	
	Winter Season.						
	1886.						
2	Grain and hay,	27.83	16.78	1.98	14.64	0.48	1:8.0
2	Grain, hay and corn fodder,	24.61	16.49	1.96	14.00	0.53	1:7.8
2	Grain, hay and ensilage,	19.73	13.01	1.35	11.16	0.47	1:9.1
2	Grain, hay and roots,	26.70	17.94	2.29	15.22	0.42	1:7.1
	General average,	24.72	16.05	1.89	13.75	0.47	1:7.9
	1887.						
3	Grain and hay,	28.45	18.41	2.53	15.20	0.59	1:6.7
3	Grain, hay and ensilage,	22.17	16.29	2.48	13.27	0.87	1:6.2
3	Grain and corn fodder,	24.35	17.18	2.11	14.50	0.57	1:7.6
3	Grain, hay and carrots,	22.69	16.41	2.54	13.44	0.60	1:5.9
	General average,	24.42	17.07	2.42	14.10	0.66	1:6.6
	1888.						
6	Grain and hay,	25.47	16.12	2.35	13.40	0.58	1:6.3
6	Grain and corn fodder,	23.80	16.33	2.43	13.23	0.67	1:6.2
6	Grain and corn stover,	19.28	13.69	2.21	10.89	0.58	1:5.6
6	Grain, hay and ensilage,	21.63	14.71	2.30	11.83	0.59	1:6.0
	General average,	22.54	15.21	2.32	12.34	0.61	1:6.0

1. *Milch Cows* — Continued.

Number of Cows.	Kind of Feed.	Total Dry Matter (Pounds).	Digestible Matter consumed Daily per 1,000 Pounds Live Weight. Organic Matter (Pounds).	Protein (Pounds).	Carbohydrates (Pounds).	Fat (Pounds).	Nutritive Ratio.
	Winter Season.						
	1889.						
9	Grain and hay,	26.64	17.46	2.56	14.39	0.51	1:6.1
6	Grain and corn fodder,	18.95	14.39	2.23	11.69	0.47	1:5.8
5	Grain and corn stover,	19.42	14.77	2.16	12.15	0.46	1:6.1
7	Grain, hay and ensilage,	24.58	17.83	2.54	14.41	0.88	1:6.5
5	Grain, hay and carrots,	22.52	16.53	2.42	13.62	0.48	1:6.2
5	Grain, hay and sugar beets,	25.38	19.09	2.78	15.82	0.49	1:6.1
	General average,	22.91	16.68	2.45	13.68	0.55	1:6.1
	1890.						
6	Grain and rowen,*	27.31	17.25	3.11	13.47	0.68	1:4.88
3	Grain, hay and ensilage,	26.32	18.26	2.69	14.57	0.99	1:6.30
5	Grain, corn fodder and carrots,	21.87	15.08	2.62	12.07	0.49	1·5.10
6	Grain, corn stover and carrots,	22.16	16.20	2.72	12.91	0.57	1:5.31
5	Grain, hay and turnips,	25.70	17.09	2.81	13.73	0.54	1:5.40
	General average,	24.67	16.78	2.80	13.35	0.65	1:5.35
	1891.						
6	Grain and hay,*	24.98	16.17	2.39	13.33	0.57	1:6.15
7	Grain and rowen,	26.52	16.30	3.09	13.07	0.78	1:5.00
5	Grain, hay and corn and soja bean ensilage.	29.10	19.14	3.77	14.29	1.08	1:4.50
5	Grain and corn stover,	22.36	15.91	2.31	12.98	0.61	1:6.30
	General average,	25.74	16.88	2.89	13.42	0.76	1:5.30
	Wolff's standard,	-	15.93	2.66	12.67	0.60	1:5.30
	Summer Season.						
	1887.						
5	Grain and hay,	26.85	16.44	1.79	14.06	0.51	1:8.52
3	Grain, hay and vetch and oats (green),	31.39	17.46	2.32	13.36	0.67	1:6.53
3	Grain, hay and cow-pea,	34.17	21.33	2.23	18.50	0.69	1:9.07
3	Grain, hay and serradella,	33.02	17.40	2.67	14.13	0.60	1:5.85
	General average,	31.36	18.16	2.25	15.01	0.62	1:7.40

* The *absolute quantity* of the different grains was constant throughout the year's experiment. At times, however, one kind was substituted for another.

1. *Milch Cows* — Concluded.

Number of Cows.	Kind of Feed.	Total Dry Matter (Pounds).	Digestible Matter consumed Daily per 1,000 Pounds Live Weight. Organic Matter (Pounds).	Protein (Pounds).	Carbohydrates (Pounds).	Fat (Pounds).	Nutritive Ratio.
	Summer Season.						
	1888.						
5	Grain and hay,	27.74	17.25	2.60	14.08	0.58	1:6.00
5	Grain and rowen,	29.50	18.49	3.27	14.56	0.63	1:4.93
5	Grain, hay and vetch and oats,	30.49	18.98	3.05	15.20	0.59	1:5.55
5	Grain, hay and cow-pea,	29.88	19.04	3.66	15.04	0.65	1:4.55
	General average,	29.40	18.44	3.14	14.72	0.61	1:5.20
	1889.						
6	Grain and hay,	25.19	16.10	2.35	13.44	0.50	1:6.25
6	Grain, hay and serradella,	25.88	17.05	3.17	13.37	0.58	1:4.57
6	Grain, hay and vetch and oats,	23.41	15.01	2.15	12.34	0.52	1:6.34
6	Grain, hay and cow-pea,	25.33	17.03	2.49	13.94	0.60	1:6.20
	General average,	24.95	16.30	2.54	13.27	0.55	1:5.80
	1890.						
6	Grain and rowen,	28.42	18.13	3.26	14.17	0.70	1:4.9
6	Grain, hay and vetch and oats,	27.35	17.58	2.76	14.19	0.64	1:5.7
6	Grain, hay and soja bean,	31.05	19.36	3.59	15.62	0.65	1:4.8
	General average,	28.94	18.36	3.20	14.66	0.66	1:5.1
	1891.						
5	Grain, rowen and vetch and oats,	33.47	19.14	2.77	15.59	0.78	1:6.3
5	Grain, rowen and soja bean,	29.66	18.84	3.32	14.37	0.65	1:5.0
	General average,	31.56	18.94	3.04	14.98	0.71	1:5.6
	Wolff's standard,	-	15.93	2.66	12.67	0.60	1:5.3

2. *Steers.*

Number of Steers.	Age (Years).	Kind of Feed.	Total Dry Matter (Pounds).	Digestible Matter consumed Daily per 1,000 Pounds Live Weight. Organic Matter (Pounds).	Protein (Pounds).	Carbohydrates (Pounds).	Fat (Pounds).	Nutritive Ratio.
		1889-90.						
2	1	Grain and corn stover,	13.72	9.83	1.78	7.61	0.43	1:4.8
2	1	Grain and corn ensilage,	25.91	18.21	3.24	13.95	1.15	1:5.2
2	1	Grain and corn fodder,	19.63	13.63	2.47	10.56	0.60	1:4.9
2	1	Grain, corn stover and sugar beets,	14.86	11.15	2.13	8.54	0.48	1:4.6
		General average,	18.53	12.95	2.41	10.16	0.67	1:4.9
		1890-91.						
3	1	Grain and hay,	20.54	12.41	2.45	9.36	0.59	1:4.5
3	1	Grain, hay and roots,	21.89	13.50	2.79	10.08	0.62	1:4.5
3	1	Grain, hay and ensilage,	20.49	12.50	2.75	9.03	0.72	1:4.0
		General average,	20.97	12.80	2.66	9.49	0.64	1:4.3
		Wolff's standard,	-	15.08	2.17	12.54	0.37	1:6.25
		1889-90.						
2	2	Grain and corn stover,	11.95	8.49	1.42	6.73	0.34	1:5.5
2	2	Grain and corn ensilage,	20.79	14.22	2.02	11.33	0.86	1:6.6
2	2	Grain and corn fodder,	15.51	10.89	1.94	8.48	0.47	1:4.9
		General average,	16.10	11.20	1.79	8.85	0.56	1:5.7
		1890-91.						
2	2	Grain, hay and turnips,	19.87	12.68	2.55	9.59	0.55	1:4.3
2	2	Grain and ensilage,	18.33	11.75	2.32	8.84	0.59	1:4.4
2	2	Grain and hay,	19.36	11.69	2.32	8.81	0.56	1:4.4
		General average,	19.19	12.04	2.39	9.08	0.57	1:4.4
		1891-92.						
3	2	Grain, hay and roots,	16.75	11.19	1.82	8.90	0.47	1:5.6
3	2	Grain and ensilage,	13.48	9.44	1.63	7.24	0.36	1:5.3
3	2	Grain and corn stover,	14.23	9.92	1.65	7.83	0.44	1:5.4
		General average,	14.82	10.18	1.70	7.99	0.42	1:5.4
		Wolff's standard,	-	15.08	2.17	12.54	0.37	1:6.25

3. *Lambs.*

Number of Lambs.	Age (Months).	Kind of Feed.	Total Dry Matter (Pounds).	Digestible Matter consumed Daily per 1,000 Pounds Live Weight.				Nutritive Ratio.
				Organic Matter (Pounds).	Protein (Pounds).	Carbohydrates (Pounds).	Fat (Pounds).	
		1889-90.						
		Narrow Ration.						
3	8-12	Grain and rowen, ...	31.37	20.15	3.88	15.38	0.89	1:4.5
3	8-12	Grain, rowen and corn ensilage, .	28.58	19.53	3.47	15.03	1.03	1:5.1
3	8-12	Grain and corn ensilage, . . .	23.68	15.81	2.89	12.90	1.02	1:5.3
		General average, . . .	27.88	18.49	3.41	14.44	0.98	1:5.0
		Wide Ration.						
3	8-12	Grain and rowen, ...	27.48	14.60	2.31	14.68	0.61	1:7.0
3	8-12	Grain, rowen and ensilage, . .	21.42	14.50	1.71	12.15	0.64	1:8.0
3	8-12	Grain and ensilage, ...	22.26	15.54	2.55	12.05	0.94	1:5.6
		General average, . . .	23.72	14.88	2.19	12.96	0.73	1:6.8
		1890-91.						
		Wide Ration.						
3	8-12	Grain and rowen, ...	28.85	19.16	3.09	15.26	0.81	1:5.7
3	8-12	Grain, rowen and ensilage, . .	23.60	17.04	2.16	14.24	0.64	1:7.3
		General average, . . .	26.22	18.10	2.62	14.75	0.73	1:6.5
		Narrow Ration.						
3	8-12	Grain and rowen, ...	31.90	19.93	3.92	15.09	0.92	1:4.45
3	8-12	Grain, rowen and ensilage, . .	24.59	16.40	2.88	12.75	0.77	1:5.10
		General average, . . .	28.24	18.16	3.40	13.92	0.84	1:4.77
		1891-92.						
6	8-12	Grain and rowen, ...	22.38	14.38	2.62	11.05	0.71	1:4.8
6	8-12	Grain, rowen and ensilage, . .	20.38	13.53	2.33	10.49	0.71	1:5.2
6	8-12	Grain, rowen and mangolds, . .	20.19	14.55	2.49	11.54	0.52	1:5.2
		General average, . . .	20.98	14.12	2.48	11.03	0.65	1:5.1
		Wolff's standard, . . .	-	17.58	3.08	14.08	0.42	1:5.0

PART II.

ON

FIELD EXPERIMENTS

AND

OBSERVATIONS IN VEGETABLE PHYSIOLOGY

AND

PATHOLOGY.

1. Field Experiments to ascertain the Effect of the Exclusion of Every Form of Nitrogen-containing Manurial Matter from the Fertilizer applied for the Production of a Leguminous Crop — Soja Bean — on its Yield per Acre (Field A).
2. Field Experiments with Prominent Varieties of Grasses and with Grass Mixtures under fairly Corresponding Circumstances (Field B).
3. Field Experiments regarding the Effect of Different Combinations of Commercial Fertilizers on the Yield of Some Prominent Garden Crops (Field C).
4. Observations regarding the Adaptation of a Variety of More or Less Reputed Fodder Plants new to our Section of the Country (Field D).
5. Field Experiments with Different Commercial Phosphates, to study the Economy of using the Cheaper Natural Phosphates or the More Costly Acidulated Phosphates (Field F).
6. Field Experiments with Mixed Forage Crops for Green Fodder and Hay, Vetch and Oats, Canada Peas and Oats.
7. Observations on Permanent Grass Lands — Meadows.
8. Report on General Farm Work.
9. Report of Prof. James E. Humphrey on Various Diseases of Plants, with Observations in the Field and Vegetation House.

1. FIELD EXPERIMENTS CARRIED ON FOR THE PURPOSE OF ASCERTAINING THE EFFECT OF THE EXCLUSION OF EVERY FORM OF NITROGEN-CONTAINING MANURIAL MATTER FROM THE FERTILIZER APPLIED FOR THE PRODUCTION OF A LEGUMINOUS CROP (CLOVER-LIKE PLANTS) ON THE YIELD, AS COMPARED WITH THE RESULTS OBTAINED WHEN A LIBERAL AMOUNT OF VARIOUS NITROGEN-CONTAINING MANURIAL SUBSTANCES IS APPLIED UNDER OTHERWISE CORRESPONDING CIRCUMSTANCES FOR THE SAME PURPOSE.*

Field A.

The unbroken record of this field extends over more than twenty years. The systematic treatment of the soil, as far as modes of cultivation and of manuring are concerned, was introduced during the season of 1883–84. The subdivision of the entire area into eleven plats (one-eighth of an acre each), of a uniform size and shape, one hundred and thirty feet long and thirty feet wide, with an unoccupied and unmanured space of five feet in width between adjoining plats, has been retained unaltered since 1884. A detailed statement of the particular aim and general management of our experiments, as well as of the results obtained in that connection from year to year, forms a prominent part of our contemporary printed annual reports, to which I have to refer for details.

Since 1889 the main object of observations upon the same field has been to study the influence of an entire exclusion of any additional nitrogen-containing manurial substance from the soil under cultivation, as well as of a definite additional supply of nitrogen in different forms of combination, on the character and yield of the crop selected for the trial. The treatment of the soil adopted in preceding years favored this new project for field observations.

Several plats which for five preceding years did not receive any nitrogen compound for manurial purposes were retained in that state, to study the effect of an entire exclusion of

* Soja bean served for the observation.

nitrogen-containing manurial substances on the crop under cultivation, while the remaining ones received as before a definite amount of nitrogen in the same form in which they had received it in preceding years; namely, either as sodium nitrate or as ammonium sulphate, or as organic nitrogenous matter in form of dried blood. A corresponding amount of available nitrogen was applied in all these cases.

Aside from the difference regarding the nitrogen supply, all plats were treated alike. They each received without an exception a corresponding amount of available phosphoric acid and of potassium oxide. The phosphoric acid was supplied in form of dissolved bone-black, and the potassium oxide either in form of muriate of potash or of potash-magnesia sulphate. From 120 to 130 pounds of potassium oxide, from 80 to 85 pounds of available phosphoric acid and from 40 to 50 pounds of available nitrogen were supplied per acre.

One plat marked 0 received its main supply of phosphoric acid, potassium oxide and nitrogen in form of barn-yard manure; the latter was carefully analyzed before being applied, to determine the amount required to secure, as far as practicable, the desired corresponding proportion of essential fertilizing constituents. The deficiency in potassium oxide and phosphoric acid was supplied by potash-magnesia sulphate and dissolved bone-black. The fertilizer for this plat consisted of 800 pounds of barn-yard manure, 32 pounds of potash-magnesia sulphate and 18 pounds of dissolved bone-black.

The mechanical preparation of the soil, the incorporation of the manurial substances, — the general character of the latter being the same, — the seeding, cultivating and harvesting were carried on year after year in a like manner, and as far as practicable on the same day in case of every plat during the same year.

This course in the general management of the experiment has been followed thus far for three successive years — 1889, 1890 and 1891 — in connection with different crops: —

Corn (maize), in 1889 (see seventh annual report); oats, in 1890 (see eighth annual report); rye, in 1891 (see ninth annual report).

The following tabular statement shows the annual application and special distribution of the manurial substances with reference to each plat since 1889. The fertilizers were in every case applied broadcast as early as circumstances permitted. They were slightly harrowed under before the seed was planted in rows by a seed drill. Each plat received the same amount of seed.

Plats.	Annual Supply of Manurial Substances.
Plat 0,	800 lbs. of barn-yard manure, 32 lbs. of potash-magnesia sulphate and 18 lbs. of dissolved bone-black.
Plat 1, .	29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 2, .	29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8 5 lbs. available phosphoric acid).
Plat 3, .	43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 4, .	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 5, .	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 6, .	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 7, .	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 8, .	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 9, .	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 10, .	43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).

1892. — The field was ploughed April 19 and 20. The barn-yard manure was applied to Plat 0 April 15; the remaining plats, 1–10, received May 6 their different mixtures of commercial fertilizers, broadcast, after which the entire field was harrowed and rolled. The seed was sown in drills two and one-half feet apart May 16, at the rate of seven pounds to each plat.

The soja bean seed, a late maturing variety, was bought of J. M. Thorburn & Co., New York City, at eight cents per pound. The crop was cut for ensilage September 8.

The young plants appeared above ground May 28; they were cultivated and hoed June 3 and July 17, when they

shaded the ground sufficiently to prevent any serious appearance of weeds. The variation in the color of the crop was quite marked in different plats during the earlier stages of its growth. Those plats which received an addition of nitrogen in form of nitrate of soda showed a deeper green color than those which received other forms of nitrogen, in particular, sulphate of ammonia; while those that received no addition of nitrogen maintained a light green color until the close of the season.

Height of the Plants upon Different Plats during the Season.

Plats.	July 8.	July 15.	July 22.	July 29.	Aug. 5.	Aug. 12.	Aug. 19.	Aug. 26.	Sept. 2.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
Plat 0, . .	13	17	25	30	31	36	41	44	44
Plat 1, . .	12	17	25	30	33	38	40	44	44
Plat 2, . .	13	17	24	31	33	37	40	43	45
Plat 3, . .	13	16	24	30	35	38	41	45	46
Plat 4, . .	12	14	21	29	29½	31	34	38	39
Plat 5, . .	11	15	21	28	30	33	36	40	42
Plat 6, . .	12	16	24	30	32	34	39	42	43
Plat 7, . .	10	13	18	24	27	32	35	40	41
Plat 8, . .	8	9	13	20	22	23	29	33	35
Plat 9, . .	9	10	18	23	26	26	32	37	39
Plat 10, . .	12	14	21	27	30	34	39	42	43

Yield of Crop on Different Plats.

Cut September 7 and 8.	Weight of Green Soja Bean (Pounds).	Yield per Acre (Tons).
Plat 0, ...	2,210	11.050
Plat 1, ...	2,290	11.450
Plat 2, ...	2,290	11.450
Plat 3, ...	2,090	10.450
Plat 4, ...	1,440	7.200
Plat 5, ...	1,935	9.675
Plat 6, ...	1,970	9.850
Plat 7, ...	1,430	7.150
Plat 8, ...	1,450	7.250
Plat 9, ...	1,460	7.300
Plat 10, ...	1,490	7.450

Analysis of the Plants from Plat 0.

	Per Cent.
Moisture at 100° C.,	73.20
Dry matter,	26.80
	100.00

Analysis of Dry Matter.

Crude ash,	6.80
" cellulose,	30.54
" fat,	2.29
" protein,	6.82
Nitrogen-free extract matter,	53.55
	100.00

An examination of the above tabular statement of the yield of each plat shows, in every case where no additional nitrogen in any form has been applied in connection with the phosphoric acid and potash used as fertilizer (plats 4, 7, 9), a decided falling off in the yield; fully one-third less than where barn-yard manure and nitrate of soda have furnished the nitrogen supply (plats 0, 1, 2, 3).

Plat 8 shows the same exceptional condition which has been noticed in preceding years, when it seriously suffered from the attack of some parasitic enemy. The low yield of Plat 10 is evidently due to the use of a lower rate of seed, being the first plat to adjust the seed drill for a definite amount of seed.

Conclusion. — The importance of a liberal additional supply of nitrogen to the soil for a successful production of farm crops under otherwise corresponding circumstances finds a strong confirmation in our late experiments in that direction, as may be noticed in the subsequent compiled tabular statement of the results of three years' observations.

Summary of Three Years' Observations upon Field A (1890–92).

Number of Plat.	MANURIAL MATTER APPLIED.	1890. Yield of Oats.			1891. Yield of Rye.					1892.
		Crop (Pounds).	Percentage of Grain.	Percentage of Straw and Chaff.	Crop (Pounds).	Percentage of Grain.	Percentage of Straw and Chaff.	Yield of Grain (Pounds).	Yield of Straw (Pounds).	Yield of Green Soja Bean (Pounds).
Plat 0,	800 lbs. of barn-yard manure, 32 lbs. of potash-magnesia sulphate and 18 lbs. of dissolved bone-black, ...	315	38.10	61.90	470	30.21	69.79	142	328	2,210
Plat 1,	29 lbs. sodium nitrate (=4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid),	362	35.36	64.64	570	27.02	72.98	154	416	2,290
Plat 2,	29 lbs. sodium nitrate (=4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), .	365	35.34	64.66	525	25.52	74.48	134	391	2,290
Plat 3,	43 lbs. dried blood (=5 to 6 lbs. nitrogen), 25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), . .	345	33.62	66.38	475	27.37	72.63	130	345	2,090
Plat 4,	25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), ...	260	34.61	63.39	390	27.44	72.56	107	283	1,440
Plat 5,	22.5 lbs. ammonium sulphate (=4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), ...	360	39.20	60.80	530	27.36	72.64	145	385	1,935
Plat 6,	22.5 lbs. ammonium sulphate (=4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid),	385	32.21	67.79	400	25.50	74.50	102	298	1,970
Plat 7,	25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), ...	320	34.40	65.60	450	24.22	75.78	109	341	1,430
Plat 8,	22.5 lbs. ammonium sulphate (=4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), .	220	26.82	73.18	-	-	-	-	-	1,450
Plat 9,	25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), ...	290	34.83	65.17	425	25.65	74.35	109	316	1,460
Plat 10,	43 lbs. dried blood, (=5 to 6 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid),	395	35.44	64.56	425	29.41	70.59	125	300	1,490

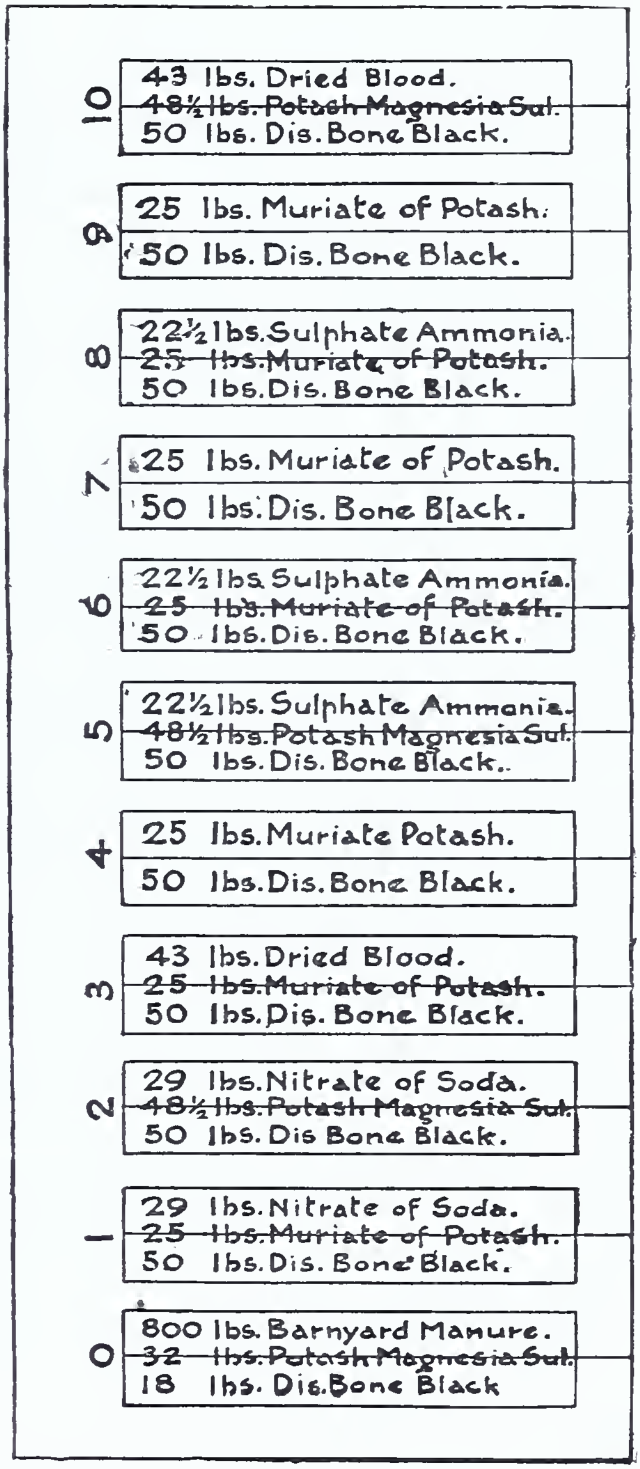
The crop when harvested, September 7 and 8, to serve for the production of a mixed ensilage (soja bean and fodder corn), showed no signs of seed pods or blossoms. It differed in this respect decidedly from other early maturing varieties, white and black soja beans, which have been raised and described by us in preceding annual reports.

The advantage, if any, of this new variety of soja bean consists in the large amount of vegetable matter it produces, as compared with the early maturing varieties.

[1. Analysis of an early variety of soja bean with pods (whole plant); 2. Analysis of soja bean seed; 3. Analysis of soja bean straw (matured plant, early variety).]

	Per Cent		
	1.	2.	3.
Moisture at 100° C.,	10.90	14.17	7.63
Dry matter,	89.10	85.83	92.37
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	6.90	5.84	10.72
" cellulose,	22.79	6.02	36.80
" fat,	6.77	20.19	3.49
" protein,	16.68	33.97	5.34
Nitrogen-free extract matter,	46.86	33.98	43.65
	100.00	100.00	100.00

Field "A," 1892.



SCALE, 4 RODS TO 1 INCH.

2. Field Experiments with Prominent Varieties of Grasses, raised either Single or in Mixture, under Otherwise Corresponding Conditions, to ascertain their Economical Value as far as Yield and Composition are concerned (1892).

Field B.

This field occupies an area of one and seven-tenths acres, and runs from north to south, nearly on a level. The soil consists of a somewhat sandy loam of several feet in depth. The systematic treatment of the area was inaugurated in 1884, when the present subdivision into eleven plats was first introduced. The plats are 175 feet long and 33 feet wide (5,775 square feet, or two-fifteenths of an acre), of a uniform shape, running from east to west, with a space of five feet between adjoining plats. The numbering begins at the north end with 11, and closes at the south end with 21. From 1884 to 1889 every alternate plat received annually the same kind and the same amount of fertilizer, — 600 pounds of fine-ground bone and 200 pounds of muriate of potash per acre. The space of five feet left between the different succeeding plats has been kept clean from any growth by a constant use of the cultivator, and received at no time any kind of manure.

The details of the work carried on upon Field B have been thus far reported from year to year in our annual reports. The chemical analyses of the crops raised upon this field, on account of the amount of work involved, have been quite frequently published in later bulletins or in annual reports of the succeeding year.

A material change in the above-stated management of the field was made in 1889, with reference to the previously unmanured plats, 12, 14, 16, 18 and 20; they were subsequently annually manured in exactly the same manner as the remaining plats, receiving per acre 600 pounds of fine-ground bone and 200 pounds of muriate of potash. The character of the crops raised upon the various plats from 1888 to 1892 may be seen from the following tabular statement: —

Plats.	1889.	1890.	1891.
Plat 11,	Kentucky blue-grass,	Kentucky blue-grass, sown Sept. 24, 1889,	Kentucky blue-grass, sown Sept. 24, 1889.
Plat 12,	Kentucky blue-grass,	Kentucky blue-grass, sown Sept. 24, 1889,	Kentucky blue-grass, sown Sept. 24, 1889.
Plat 13,	Red-cob ensilage corn,	Red top, sown Sept. 24, 1889,	English rye-grass, north, sown Sept. 29, 1889. Italian rye-grass, south, sown Sept. 29, 1889.
Plat 14,	Red-cob ensilage corn,	Red top, sown Sept. 24, 1889,	English rye-grass and red top, sown Sept. 29, 1890.
Plat 15,	Bokhara clover (*Melilotus alba*), Sainfoin (*Onobrychis sativa*),	Bokhara clover, sown May 8, 1889, Sainfoin, sown May 8, 1889,	Herds grass and red top, sown April 23, 1890.
Plat 16,	Bokhara clover, Sainfoin,	Rhode Island bent (*Agrostis alba*), sown Sept. 25, 1889,	Italian rye-grass and red top, sown April 23, 1890.
Plat 17,	Meadow fescue,	Meadow fescue, sown September, 1887,	Meadow fescue, sown September, 1887.
Plat 18,	Red-cob ensilage corn,	Meadow fescue, sown September, 1889,	Meadow fescue, sown Sept. 29, 1890.
Plat 19,	Alsike clover, Medium red clover,	Herds grass, sown September, 1889,	Herds grass, sown Sept. 25, 1889.
Plat 20,	Red-cob ensilage corn,	Red top and herds grass mixed, sown September, 1889,	Herds grass and red top, sown Sept. 29, 1890.
Plat 21,	Corn (variety, Clark),	Meadow fescue and herds grass, mixed, sown September, 1889,	Meadow fescue and red top, sown Sept. 29, 1890.

1891. — Previous to the year 1891 other crops than grasses have been cultivated upon some plats at times. Of late none but single grasses or mixtures of reputed grasses have been planted. The single grasses are raised as in previous years, in rows two feet apart; grass mixtures are seeded down broadcast. The manure in case of single grasses is applied by hand between the rows, and is subsequently slightly ploughed in by means of a cultivator; in case of grass mixtures the manure is applied as top dressing early in the spring. In both cases the first manure is applied broadcast and ploughed under before seeding down the grass.

Crops raised in 1892.

Plats.	1892.
Plat 11, .	Kentucky blue-grass, sown Sept. 24, 1889.
Plat 12, .	Kentucky blue-grass and red top, sown Sept. 18, 1891.
Plat 13,	English rye-grass and Italian rye-grass, sown Sept. 29, 1890.
Plat 14, .	English rye-grass and red top, sown Sept 29, 1890.
Plat 15, .	Herds grass and red top, sown April 23, 1891.
Plat 16, .	Italian rye-grass and red top, sown April 23, 1891
Plat 17, .	Meadow fescue, sown Sept. 25, 1887.
Plat 18, .	Meadow fescue, sown Sept. 29, 1890.
Plat 19, .	Herds grass, sown Sept. 25, 1889.
Plat 20, .	Herds grass and red top, sown Sept. 29, 1890.
Plat 21, .	Meadow fescue and herds grass, sown Sept. 18, 1891.

Area of Each Plat, Two-fifteenths Acre.	Yield of Hay, First and Second Cut (Pounds).	Rate per Acre (Pounds).
Plat 11, sown Sept. 24, 1889, ...	335	2,513
Plat 12, sown Sept. 18, 1891, ...	365	2,737
Plat 13, sown Sept. 29, 1890, ...	255	1,913
Plat 14, sown Sept. 29, 1890, ...	225	1,688
Plat 15, sown April 23, 1891, ...	565	4,238
Plat 16, sown April 23, 1891, ...	565	4,238
Plat 17, sown Sept. 25, 1887, ...	475	3,563
Plat 18, sown Sept. 29, 1890, ...	490	3,675
Plat 19, sown Sept. 25, 1889, ...	610	4,575
Plat 20, sown Sept. 29, 1890, ...	285	2,138
Plat 21, sown Sept. 18, 1891, ...	355	2,663
Total, ...	4,525	

Field "B," 1892.

21	Meadow Fescue and Herds Grass.
20	Herds Grass and Red Top.
19	Herds Grass.
18	Meadow Fescue.
17	Meadow Fescue.
16	Italian Rye-grass and Red Top.
15	Herds Grass and Red Top.
14	English Rye-grass and Red Top.
13	English Rye-grass and Italian Rye-grass.
12	Kentucky Blue-grass and Red Top.
11	Kentucky Blue-grass.

Scale, 4 rods to 1 inch.

3. Field Experiments regarding the Effect of Different Combinations of Commercial Fertilizers on the Yield and the Character of Several Prominent Garden Crops (1892).

Field C.

1891. — The observations upon Field C with different combinations of commercial fertilizers on the yield and character of some prominent garden crops began during the spring of 1891. The portion of Field C devoted to this experiment during 1891 consisted of one-half of its entire area, running from east to west along its south side (328 feet long and 88 feet wide). It was subdivided into five plats of corresponding size and shape (88 by 62 feet), one-eighth of an acre. These plats were separated from each other and from other cultivated land adjoining by a space of five feet of unmanured and unseeded land. The soil is several feet deep, and consists of a rather light loam in a good state of cultivation; 600 pounds of fine-ground bone and 200 pounds of muriate of potash per acre were used for several years previous to 1891 as the annual manure supply. The field slopes gently from west to east. The plats were numbered 1, 2, 3, 4, 5, beginning at the east end of the field. Each plat received during the spring of 1891 a manurial mixture of its own as fertilizer.

The difference of the fertilizers applied consisted essentially in the circumstance that nitrogen and potash were used in several of them in different forms. All plats received practically the same quantity of nitrogen, potash and phosphoric acid, and every one of them received its phosphoric acid addition in the same form, namely, dissolved bone-black. Some plats received their nitrogen supply in the form of organic animal matter, dried blood; others received their nitrogen in the form of sodium nitrate, Chili saltpetre; others in the form of ammonium sulphate. Some plats received their potash in the form of muriate of potash and others in the form of the highest grade of potassium sulphate (in our market 95 per cent.). The subsequent tabular statement shows the quantities of the manurial substances applied to different plats: —

Plat 1, . . .	75 pounds dried blood. 30 pounds muriate of potash. 40 pounds dissolved bone-black.
Plat 2, . . .	47 pounds nitrate of soda. 30 pounds muriate of potash. 40 pounds dissolved bone-black.
Plat 3, . . .	38 pounds sulphate of ammonia. 30 pounds muriate of potash. 40 pounds dissolved bone-black.
Plat 4, . . .	47 pounds nitrate of soda. 30 pounds high-grade sulphate of potash. 40 pounds dissolved bone-black.
Plat 5, . . .	38 pounds sulphate of ammonia. 30 pounds high-grade sulphate of potash. 40 pounds dissolved bone-black.

		Pounds.
Per acre:	Phosphoric acid,	50.4
	Nitrogen,	60.0
	Potassium oxide,	120.0

The different fertilizers were applied broadcast, and subsequently slightly ploughed under, in all cases on the same day (April 22, 1891). All plats were planted in the same order with the same kind of garden crops (eight). Every plat was either planted with young plants or was sown with the seed, as circumstances dictated, each kind on the same day and in the same manner. The young plants used for the experiment were raised under corresponding conditions from seed in a hot-bed. The different kinds of garden crops were arranged in the following order, beginning on the east side of each plat: —

Lettuce, White Tennis Ball, one row.
Spinach, Long Standing and Bloomingdale, one row each.
Beets, Egyptian and Dewings, one row each, or two of a kind.
Celery, White Plume, one row.
Kohlrabi, two rows.
Cabbage, Red Dutch and several white varieties, three rows in all.
Tomatoes, Boston Market, two rows.
Potatoes, Beauty of Hebron, five rows.

The details of the results are recorded in our ninth annual report. Being the first year's observation, no serious attempt was made to account for the differences in the yield upon different plats.

1892. — During the spring of 1892 it was thought best to make such alteration in the location of the plats as would

secure as far as practicable a corresponding level position for all of them, and thereby remove the objection of the possible influence of a more or less inclined position and different state of moisture of one or the other on the results.

For this purpose the entire width of Field C on its western termination was selected for the future trial. The field thus marked out covered an area 189 feet long and 164 feet wide. It was subdivided into six plats of equal size and shape (88 by 62 feet), corresponding thus in this particular with those in the preceding year. Three plats of the previous year, 3, 4 and 5, remained unchanged; their numbers were altered into 6, 5 and 4. The new plats were numbered 1, 2, 3, beginning at the west end of the field. The entire area was ploughed April 19, and subsequently staked out as above stated into six plats, with four feet unoccupied space between them. The below specified fertilizer mixture was applied to each plat broadcast, and the soil subsequently harrowed. On May 10 it was rolled. All the crops were planted in rows two and one-half feet apart; the different crops were seeded or planted each on the same day in all the plats. The crops were arranged in all plats in the same order, which, in the interest of a desirable rotation, differed from that in the preceding year (plats 4, 5, 6).

Plats.		Annual Supply of Manurial Substances.	Pounds.
Plat 1,	*First Year.*	Sulphate of ammonia,	38
		Muriate of potash,	30
		Dissolved bone-black,	40
Plat 2,		Nitrate of soda,	47
		Muriate of potash,	30
		Dissolved bone-black,	40
Plat 3,		Dried blood,	75
		Muriate of potash,	30
		Dissolved bone-black,	40
Plat 4,	*Second Year.*	Sulphate of ammonia,	38
		Sulphate of potash,	30
		Dissolved bone-black,	40
Plat 5,		Nitrate of soda,	47
		Sulphate of potash.	30
		Dissolved bone-black.	40
Plat 6,		Dried blood,	75
		Sulphate of potash,	30
		Dissolved bone-black,	40

Plats 1, 2 and 3 have been treated with the stated fertilizers this year only; plats 4, 5 and 6 have been treated two years.

The following order in arranging the different crops was adopted in 1892, beginning in each plat at its west end. The rows run in all plats from south to north (88 feet long): —

Two rows of celery, variety Dwarf Golden Heart.
Two rows of lettuce, variety Hanson.
Two rows of spinach, variety New Zealand.
Four rows of beets, variety Edmund's Blood Turnip.
Four rows of cabbages, variety Savoy (one row); variety Fottler's (two rows); variety Red Dutch (one row).
Two rows of tomatoes, variety Essex Hybrid.
Five rows of potatoes, variety Beauty of Hebron.

Potatoes were planted May 9; spinach and beets were sown May 10; lettuce and cabbage plants were set out May 13; tomato plants were set out May 21; celery plants were set out June 9.

The seeds in every case were taken from the same lot; the young plants were raised under corresponding conditions in the same hot-bed, and a corresponding number transplanted in each plat. All plats were kept clean from weeds and treated in a like manner during the season. The crops were harvested whenever fit for the market. The subsequent tabular statements of the yield of the crops show the date of maturity and the quantity obtained at different dates: —

Yield of Celery (Variety Dwarf Golden Heart).

Plats.	Number of Perfect Heads.
Plat 1 (two rows),	46
Plat 2 (one row),	43
Plat 3 (one row),	69
Plat 4 (two rows),	61
Plat 5 (one row),	62
Plat 6 (one row),	52

The plants were set out June 9; they were harvested October 20.

Yield of Lettuce (Variety Hanson).

Plats.	Pounds.
Plat 1 (two rows; seventy heads),	41½
Plat 2 (two rows; seventy heads),	36
Plat 3 (two rows; seventy heads),	43
Plat 4 (two rows; seventy heads),	76
Plat 5 (two rows; seventy heads),	60
Plat 6 (two rows; seventy heads),	36

The plants were set out May 13; they were harvested July 1.

Yield of Spinach (Variety New Zealand).

Plats.	Pounds.
Plat 1 (two rows),	192
Plat 2 (two rows),	233
Plat 3 (two rows),	202
Plat 4 (two rows),	230
Plat 5 (two rows),	232
Plat 6 (two rows),	134

The seed was sown May 10; crop was harvested July 11.

Yield of Beets (Variety Edmund's Blood Turnip).

Plats.	Pounds.
Plat 1 (four rows),	350
Plat 2 (four rows),	345
Plat 3 (four rows),	515
Plat 4 (four rows),	455
Plat 5 (four rows),	509
Plat 6 (four rows),	495

The seed was sown May 10; crop was harvested October 14.

Yield of Cabbages.

Plats.	Savoy, One Row in Plat.	Fottler's, Two Rows in Plat.	Red Dutch, One Row in Plat.
	Pounds.	Pounds.	Pounds.
Plat 1,	100	534	201
Plat 2,	113	762	350
Plat 3,	116	576½	330
Plat 4,	107	458	325
Plat 5,	110	674	340
Plat 6,	107	586	241

The plants were set out May 13. Savoy cabbages were harvested August 8; Fottler's cabbages were harvested August 12–29; Red Dutch cabbages were harvested September 29; fed to cows and steers.

Each plat contained: —

	Heads.
Savoy cabbages,	31
Fottler's cabbages,	62
Red Dutch cabbages,	31

Yield of Tomatoes (Variety Essex Hybrid).

Date of Harvesting.	Plats.					
	1	2	3	4	5	6
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
August 15,	36	43¾	40	36¾	39½	16¼
August 17,	42¼	49	48¾	40¾	48	35¾
August 19,	27¾	39¼	30¾	29¾	38	14¾
August 22,	56	103	51¼	69½	109¼	21½
August 24,	29¼	49	31¾	30¼	45½	7¾
August 29,	19	23	20½	33	33½	15½
August 31,	51¾	54	36¾	63½	51½	39½
September 2,	20¾	21	21	21½	14	25½
September 5,	40¾	42	45½	42½	44½	38½
September 8,	29	30	24	21	34	21
September 10,	34½	44	39	57½	39½	26
September 16,	56	50	50	55	79	25
September 19,	21	19	28	15	18	47
Total,	464	572	466	515	593	332

Seed was obtained of Gregory & Son, Marblehead, Mass. There were two rows in each plat and twenty-two plants in

a row. The tomato plants were set out from the hot-bed May 21, came in bloom June 23 and began to form tomatoes July 7.

Yield of Potatoes (Variety Beauty of Hebron).

Plats.	Pounds.
Plat 1 (five rows), ...	731
Plat 2 (five rows), ...	665
Plat 3 (five rows), ...	545
Plat 4 (five rows), ...	640
Plat 5 (five rows), ...	740
Plat 6 (five rows), ...	435

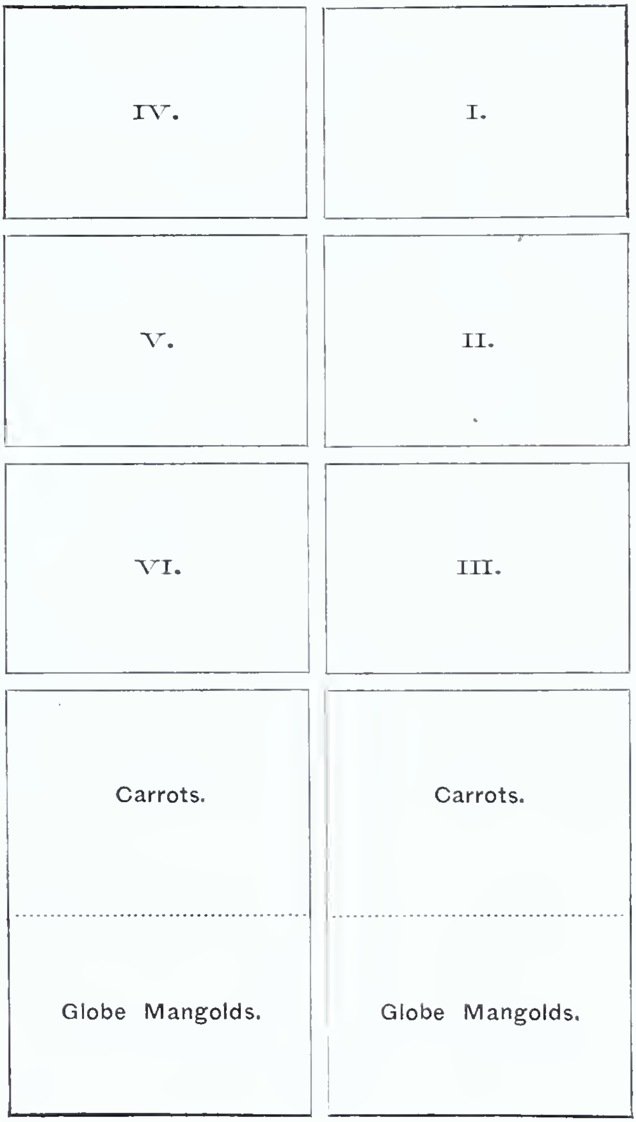
The potatoes were planted May 9; were dug August 17.

Field C, Eastern Portion.

The portion of Field C east of the plats is 183 by 131 feet, and contains .55 acres. The fertilizer applied consisted of 300 pounds of fine-ground bone and 100 pounds of muriate of potash (rate of 600 pounds bone and 200 pounds muriate of potash per acre). It was spread on broadcast May 5, and harrowed in.

The western half of the piece was sown to carrots (variety Danvers) and the eastern half to globe mangolds (variety Yellow Globe) May 14, in drills two and one-half feet apart. May 30 the young plants broke ground. The globe mangolds were harvested October 17; yield, 9,635 pounds (rate of 17 tons 1,680 pounds per acre). The carrots were harvested October 31; yield, 5,545 pounds (rate of 10 tons 530 pounds per acre).

Field "C," 1892.



Scale, 4 rods to 1 inch.

4. Experiments with a Variety of New Forage Crops (1892).

Field D.

This field is 328 feet long and 70 feet wide (east to west); it covers an area of 22,960 square feet, or .527 acres. During previous years it has been used for the cultivation of a variety of annual farm and garden crops, and has been manured most of the time annually with a mixture of muriate of potash and ground bone, at the rate of two hundred pounds of the former and six hundred pounds of the latter per acre.

During the past season it has served for the raising of a variety of reputed annual and perennial fodder crops, in the majority of cases new to our section of the country, for the purpose of studying their adaptation to our climate and soil.

The field was ploughed April 19, and manured with three hundred pounds ground bone and one hundred pounds muriate of potash. It was harrowed and prepared for planting May 10. The different crops were planted in rows two and one-half feet apart, to admit of the use of a horse cultivator: all were subsequently kept clean by means of the cultivator and hoe. They were arranged in the field in the following order, beginning at the west end of the field: —

Artichoke, Jerusalem (*Helianthus tuberosus*).
Prickley comfrey (*Symphytum officinale*).
Pyrethrum (*Pyrethrum roseum*).
Forest pea (*Lathyrus sylvestris*).
Stachy's tubers (*Stachys affinis*).
Kidney vetch (*Anthyllis vulneraria*).
Winter rape (*Brassica Napus*).
Sainfoin (*Onobrychis sativa*).
Yellow trefoil (*Trifolium agrarium*).
Spring vetch (*Vicia sativa*).
Bokhara clover (*Melilotus alba*).
Summer rape (*Brassica Napus*).
Common English horse bean (*Vicia faba*).
Serradella (*Ornithopus sativus*).
Soja bean (*Soja hispida*).

Cow-pea (*Dolichos sinensis*).
Jackson wonder bean.
Blue lupine (*Lupinus cœruleus*).
White lupine (*Lupinus alba*).
Yellow lupine (*Lupinus lutens*).
Silver-hull buckwheat (*Fagopyrum esculentum*).
Japanese buckwheat (*Fagopyrum esculentum*).
Common buckwheat (*Fagopyrum esculentum*).

Artichoke, ten rows. The tubers for seed were presented by Mr. J. J. H. Gregory of Marblehead, Mass., with the request to ascertain the value of the plants as a forage crop. They were planted May 4, two feet apart in the row. The young plants appeared above the ground May 18; they began to bloom September 23, and suffered from frost October 10 (temperature 28.5° F.). The tubers were dug during the first week of November; yield, six hundred and fifty-nine pounds (rate of eight tons four hundred pounds to the acre). Some of the blooming stalks with leaves were cut and packed into suitable boxes, to ascertain their fitness for ensilage. Analyses of tubers and ensilage will be published later on.

Prickley comfrey (*Symphytum officinale*), one row. The roots used for seed were from last year's growth, in Field C. They were planted May 4. The young plants came up May 18, and bloomed June 8. The plants were cut July 8, when they were thirty inches high, and presented a rank growth of leaf and stem.

Forest pea (*Lathyrus sylvestris*), three rows. The plants used were from last year's growth, in Field C. They were transplanted May 4 and came up May 21; they reached a height of fifteen inches. The roots were remarkable in size. They were nearly two feet in length; large tubercles were quite prominent.

Stachy's tubers (*Stachys affinis*), two rows. This is the second year this plant has been raised on the station grounds. The seed tubers of last year were obtained from the United States Department of Agriculture; those of this year were from our own raising. They wintered well and were vigorous in the spring. They were planted May 4. May 18 the young plants appeared above ground. October

2 the foliage was injured by frost (temperature 33° F.). The tubers produced were scarcely one-eighth of an inch in diameter.

Kidney vetch, four rows. The seed was obtained of Henry Nungesser, New York City. One pound of seed was used, which was sown May 18. The plants came up June 1. The growth was slow, scarcely measuring three inches in the fall.

Winter rape (*Brassica Napus*), five rows. The seed was obtained of D. Landreth & Sons, Philadelphia, Pa. This plant is used quite extensively as a green fodder in sheep-growing districts. The seed was sown May 18, and June 1 the young plants appeared above ground. The growth was heavy, reaching a height of twenty inches. August 6 the crop was cut for fodder.

Sainfoin (*Onobrychis sativa*), five rows. The seed was sown May 18. The young plants appeared above ground June 1. The growth was rather slight, measuring in the fall only ten inches. The plants failed to develop blossoms. The seed was bought of Henry Nungesser, New York City, at six cents per pound.

Yellow trefoil, five rows. The seed was sown May 18. The young plants broke ground June 1. The growth was slow, reaching a height of only three inches. The plants failed to bloom. The seed was obtained of Henry Nungesser, New York City, at eleven cents per pound.

Spring vetch (*Vicia sativa*), five rows. The seed was sown May 18. The plants came up June 1, began to blossom July 11 and to form pods August 1. The growth was cut August 5, having attained a height of twenty-seven inches. The seed was obtained of J. M. Thorburn, New York City, at four and one-half cents per pound. This valuable fodder plant has served us for several years as green fodder in connection with oats.

Bokhara clover (*Melilotus alba*), five rows. The seed was sown May 18. The plants appeared above ground June 1. The leaf development was rather light. October 7 the plants were cut, having reached a height of twenty-eight inches. The seed was obtained of H. Nungesser, New York City, at twenty cents per pound.

Summer rape (*Brassica Napus*), five rows. The seed was sown May 18. The plants appeared above ground June 1. The character of the growth was very much the same as that of winter rape, described above. Four rows were cut for fodder August 6; the remaining row was left to develop farther, but was finally cut, the plants failing to blossom. The seed was obtained of D. Landreth & Sons, Philadelphia, Pa.

Common English horse bean (*Vicia Faba*), five rows. The seed was sown May 18. The plants broke ground June 1, bloomed July 5 and began to develop pods August 6. The growth was characterized by large, coarse stalks and small leaf development. Height of plants September 7 was forty-two inches. The seed was obtained of J. M. Thorburn, New York City, at nine cents per pound.

Serradella (*Ornithopus sativus*), five rows. The seed was sown May 18. The young plants appeared above ground June 1 and came in bloom July 21. The growth was heavy and of good quality. This crop furnishes an excellent green fodder. We have raised it this year at the rate of twelve tons to the acre. A silo has been filled with a mixture of serradella and Hungarian grass (3 : 1), which will be reported upon in the future. The serradella seed was obtained of H. Nungesser, New York City, at eight cents per pound.

Soja bean (*Soja hispida*), five rows. The seed was sown May 18. The young plants appeared above ground June 1 and began to bloom September 22. The growth was very good, reaching a height of about three feet, but was very light colored. October 2 the foliage was injured by frost (temperature, 33° F.). The seed was bought of J. M. Thorburn, New York City, at eight cents per pound.

Cow-pea (*Dolichos sinensis*), five and one-half rows. The seed was sown May 18. The plants broke ground June 1, came in bloom August 23 and began to form pods September 22. The plants were injured by frost October 2 (temperature, 33° F.). The seed was obtained of D. Landreth & Sons, Philadelphia, Pa.

Jackson wonder bean, one-half row. The seed was sent on for trial by the M. W. Johnson Seed Company, Atlanta, Ga. It was sown May 18. The young plants appeared

above ground June 1, blossomed during the middle of July and began to form pods August 6. The growth resembled very much the common pole bean.

Blue lupine (*Lupinus cœruleus*), five rows. The seed was sown May 18. The young plants appeared above ground June 1, blossomed July 19 and began to develop pods July 27. The growth was heavy, reaching a height of thirty-eight inches July 25. August 30 the plants were cut for seed. The lupines are considered an excellent crop for green manuring. The seed was bought of J. M. Thorburn, New York City, at fifteen cents per pound.

White lupine (*Lupinus alba*), three rows. The seed was sown May 18 and came up June 1. July 7 the plants began to bloom, and August 1 pods were forming. The growth attained a height of thirty-three inches, being somewhat lighter than that of the blue lupine. August 22 the plants were cut for seed. The seed was bought of J. M. Thorburn, New York City, at eleven cents per pound.

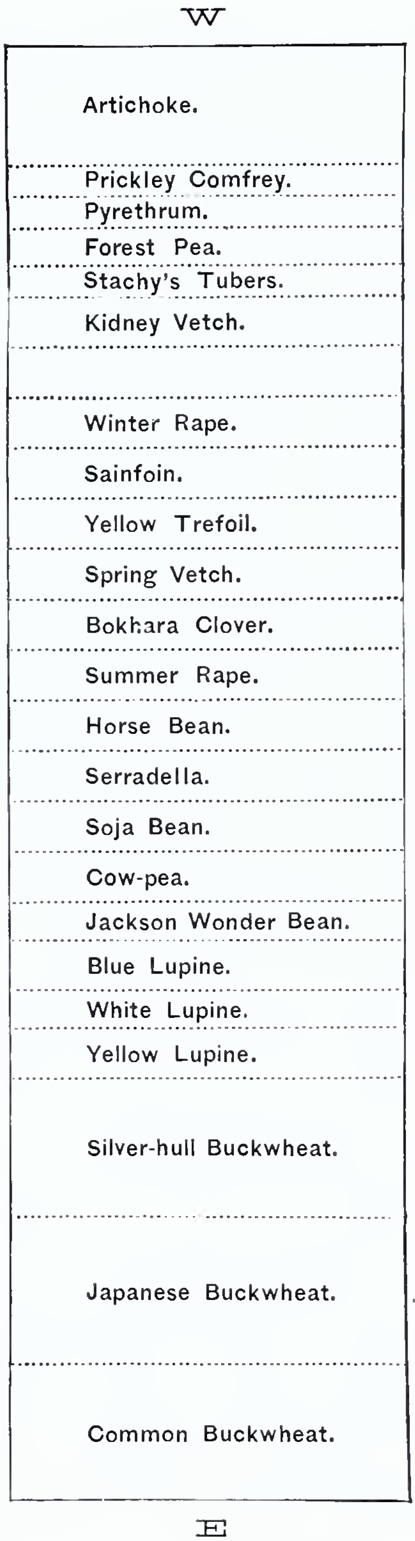
Yellow lupine (*Lupinus lutens*), five rows. The seed was sown May 18. The plants broke ground June 1, came in bloom July 21 and began to form pods August 1. This lupine shows the lightest growth of the three, reaching a height of twenty-four inches. Seed was bought of H. Nungesser, New York City, at seven cents per pound.

Silver-hull buckwheat, twelve rows. Seed was sown May 18, came up May 28. The plants made a rapid and heavy growth, measuring, July 7, thirty-four inches. They began to bloom June 25 and were cut for fodder July 11. The seed was obtained of J. M. Thorburn, New York City, at six and one-fourth cents per pound.

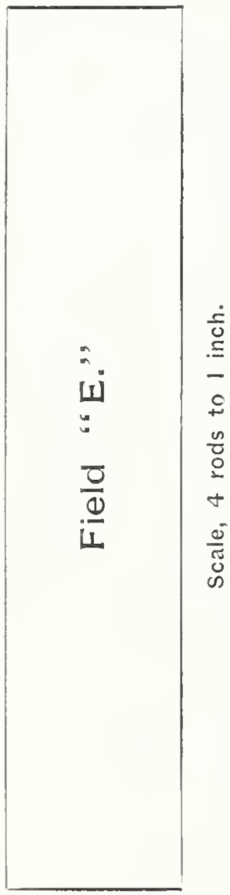
Japanese buckwheat, twelve rows. The seed was sown May 18, came up May 28. The plants began to bloom June 30 and were cut for fodder July 11; average height, thirty inches. Seed was obtained of J. M. Thorburn, at six and one-fourth cents per pound.

Common buckwheat (*Fagopyrum esculentum*), eleven rows. The seed was sown May 18. The young plants appeared above ground May 28, began to bloom June 23 and were cut for fodder July 11; average height, thirty-six inches. The seed was bought of J. M. Thorburn, at six and one-fourth cents per pound.

Field "D," 1892.



Scale, 50 feet to 1 inch.



Field E (Potatoes).

This field is 260 feet long and 48 feet wide; it contains .286 acres. The field was ploughed April 20. The following fertilizer was applied April 27: 250 pounds fine-ground bone, 75 pounds sulphate of potash, high grade, ninety-five per cent. (rate of 600 pounds bone, 200 pounds sulphate of potash, high grade, per acre approximately).

At the northern part of the field were a few rows of violets under the care of Professor Humphrey. The remainder of the field (.26 acres) was planted to potatoes (variety Beauty of Hebron), April 30, in rows two and one-half feet apart. Seven bushels of seed were used. On account of the cold weather the potato plants did not appear above ground until May 28. August 4 the potato tops began to die, and August 15 the tubers were dug. They were more or less scabby and rather poor in quality; total yield 2,775 pounds (10,673 pounds, or 212 bushels, to the acre).

5. Field Experiments with Different Commercial Phosphates to study the Economy of using the Cheaper Natural Phosphates or the More Costly Acidulated Phosphates.

Field F.

The field selected for this purpose is 300 feet long and 137 feet wide, running on a level from east to west. Previous to 1887 it was used as a meadow, which was well worn out at that time, yielding but a scanty crop of English hay. During the autumn of 1887 the sod was turned under and left in that state over winter. It was decided to prepare the field for special experiments with phosphoric acid by a systematic exhaustion of its inherent resources of plant food. For this reason no manurial matter of any description was applied during the years 1887, 1888 and 1889.

The soil, a fair sandy loam, was carefully prepared every year by ploughing during the fall and in the spring, to improve its mechanical condition to the full extent of existing circumstances. During the same period a crop was raised every year. These crops were selected, as far as practicable, with a view to exhaust the supply of phosphoric acid in particular. Corn, Hungarian grass and leguminous crops (cow-pea, vetch and serradella) followed each other in the order stated.

1890. — The field was subdivided into five plats, running from east to west, each twenty-one feet wide, with a space of eight feet between adjoining plats.

The manurial material applied to each of these five plats contained, in every instance, the same form and the same quantity of potassium and of nitrogen, while the phosphoric acid was furnished in each case in the form of a different commercial phosphoric-acid-containing article; namely, phosphatic slag, Mona guano, Florida phosphate, South Carolina phosphate (floats) and dissolved bone-black. The market cost of each of these articles controlled the quantity applied, for each plat received the same money value in its particular kind of phosphate.

Cost per Ton.

Phosphatic slag,	$15 00
Mona guano (West Indies),	15 00
Florida rock phosphate,	15 00
South Carolina phosphate (floats),	15 00
Dissolved bone-black,	25 00

Analyses of Phosphates used.

[I., phosphatic slag; II., Mona guano; III., Florida phosphate; IV., South Carolina phosphate; V., dissolved bone-black.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture,	0.17	12.52	2.53	0.39	15.96
Ash,	–	75.99	89.52	–	61.46
Calcium oxide,	46.47	37.49	17.89	46.76	–
Magnesium oxide,	5.05	–	–	–	–
Ferric and aluminic oxides,	14.35	–	14.25	5.78	–
Total phosphoric acid,	19.04	21.88	21.72	27.57	15.82
Soluble phosphoric acid,	–	0.00	–	0.00	12.65
Reverted phosphoric acid,	–	7.55	–	4.27	2.52
Insoluble phosphoric acid,	–	14.33	–	23.30	0.65
Insoluble matter,	4.39	2.45	30.50	9.04	6.26

In 1890 potatoes were raised on the plats; in 1891 winter wheat was the crop experimented with (for details see ninth annual report). The following fertilizing mixtures have been applied annually to all plats, with the exception of Plat 3, which received in 1890 ground apatite and in 1891 no phosphate whatever: —

Plats.	Annual Supply of Manurial Substances.	Pounds.
Plat 1 (south, 6,494 square feet),	Ground phosphatic slag,	127
	Nitrate of soda,	43
	Potash-magnesia sulphate,	58
Plat 2 (6,565 square feet),	Ground Mona guano,	128
	Nitrate of soda,	43½
	Potash-magnesia sulphate,	59
Plat 3 (6,636 square feet),	Ground Florida phosphate,	129
	Nitrate of soda,	44
	Potash-magnesia sulphate,	59
Plat 4 (6,707 square feet),	South Carolina phosphate,	131
	Nitrate of soda,	44½
	Potash-magnesia sulphate,	60
Plat 5 (6,778 square feet),	Dissolved bone-black,	78
	Nitrate of soda,	45
	Potash-magnesia sulphate,	61

The phosphatic slag, Mona guano, South Carolina phosphate and Florida phosphate were applied at the rate of 850 pounds per acre; dissolved bone-black at the rate of 500 pounds per acre. Nitrate of soda was applied at the rate of 290 pounds to the acre, and potash-magnesia sulphate at the rate of 390 pounds per acre.

1892. — The field was sown to serradella May 17, in drills two and one-half feet apart; thirty-two pounds of seed were used for the entire piece. The seed was bought of Henry Nungesser, New York City, at eight cents per pound. May 28 the young plants appeared above ground and were quite uniform in all the plats. July 20 the serradella came in bloom, the average height being five inches. The growth was slow at first, but during the hot days of August it made rapid strides, and at the time of cutting (September 9, 10) the plants measured on an average thirty-one inches in length, and covered the ground with a complete mat of foliage. The serradella was cut, at the time stated above, while perfectly green, and packed in a silo with Hungarian grass. Following is a statement of the yield of the several plats: —

Plats.	Weight of Green Serradella (Moisture, 82.03 Per Cent.).	Yield per Acre.
	Pounds.	Tons.
Plat 1,	4,070	13.69
Plat 2,	3,410	11.29
Plat 3,	2,750	9.05
Plat 4,	3,110	10.10
Plat 5,	2,920	9.36

Analysis of Serradella (Green).

[Station, Field F, 1892.]

	Per Cent.
Moisture at 100° C.,	82.03
Dry matter,	17.97
	100.00

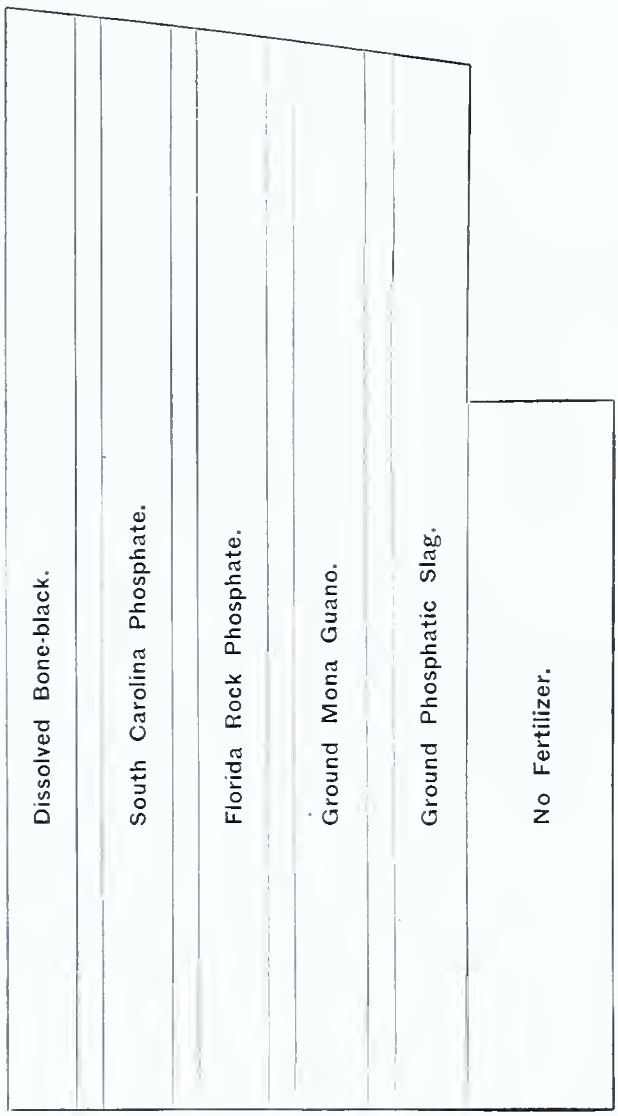
Analysis of Dry Matter.

	Per Cent.
Crude ash,	9.59
" cellulose,	26.28
" fat,	2.59
" protein,	15.13
Non-nitrogenous extract matter,	46.41
	100.00

Fertilizing Constituents.

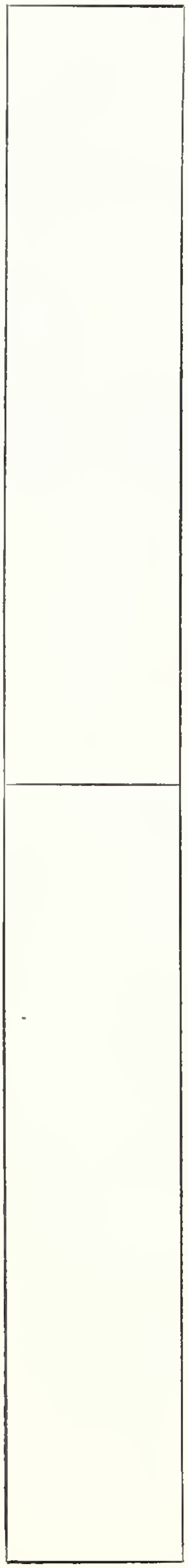
Moisture,	82.03
Nitrogen,	0.435
Phosphoric acid,	0.126
Potassium oxide,	0.379
Valuation per 2,000 pounds,	$1 78

Field "F," 1892.



Serradella.

Scale, 4 rods to 1 inch.



Field "G," 1892.

Scale, 6 rods to 1 inch.

6. Experiment with Vetch and Oats for Green Fodder and Hay (1892).

Field G.

This field is 700 feet long and 75 feet wide; area, 52,500 square feet, or $1\frac{1}{5}$ acres. The land is nearly level and the soil a loam several feet in depth. No manurial matter has been applied since 1890, the object being to reduce the stored-up plant food, and thereby prepare the soil for future field experiments with special fertilizers.

The field was ploughed April 18, and subsequently thoroughly harrowed. The northern half of the field was sown to vetch and oats April 21. Two bushels of oats and thirty-five pounds of spring vetch were used for seed. The southern half of the field was sown June 1, four bushels of oats and thirty-five pounds of spring vetch being used for seed. The plants came up May 3 on the northern half and June 6 on the southern half of the field.

We commenced cutting the crop for green fodder June 28, when the vetch was beginning to bloom and the oats to head out, beginning at the north end. The portion of the northern half cut over in this manner was 109 by 75 feet, or 8,175 square feet. The yield was 3,020 pounds (rate of 8 tons to the acre). The remainder of this half was cut and dried for hay. Yield of well-dried hay, 1,195 pounds (rate of 2,900 pounds to acre). The cutting of the southern half of the field was commenced July 12. The total yield of green fodder amounted to 3 tons 1,148 pounds (rate of 5 tons 1,900 pounds to the acre).

The analysis of vetch and oats will be found below: —

Vetch and Oats (Green).

	Per Cent.
Moisture at 100° C.,	82.02
Dry matter,	17.98
	100.00

Analysis of Dry Matter.

Crude ash,	9.31
" cellulose,	29.80
" fat,	2.79
" protein,	16.77
Non-nitrogenous extract matter,	41.33
	100.00

Fertilizing Constituents.

Moisture,	82.02
Nitrogen,	0.482
Phosphoric acid,	0.132
Potassium oxide,	0.418
Valuation per 2,000 pounds,	$1 97

Canada Peas and Oats.

[Young orchard, east fields.]

The area occupied by this crop was one acre approximately. The seed was sown broadcast April 29, 1892, two bushels of Canada peas and four bushels of oats being used. The peas were slightly ploughed in and the oats harrowed in. The young plants appeared above ground May 6, and made a rapid and luxuriant growth. Began to cut the crop for green fodder June 13, when the peas were coming in bloom. The plants attained a height of nearly three feet, and yielded five and one-half tons per acre of green fodder of the following composition: —

Analysis of Canada Peas and Oats (Green).

[Station, 1892.]

	Per Cent.
Moisture at 100° C.,	86.32
Dry matter,	13.68
	100.00

Analysis of Dry Matter.

Crude ash,	6.90
" cellulose,	26.66
" fat,	2.29
" protein,	16.01
Non-nitrogenous extract matter,	48.14
	100.00

7. Experiments with Grass Land (Meadows).

The permanent grass lands are by their location arranged into two divisions, west and east of a public highway. They cover at present a space of sixteen to seventeen acres.

The *west side division* consists of old meadows, kept for over twenty years in grass. The area has for years been steadily reduced in size by turning, as circumstances advised, more or less at a time into plats for field experiments. In their present condition they surround our main field for experimental purposes. They are in part underdrained, and are kept, by a moderate annual top-dressing with barnyard manure, in a fair state of production, considering the condition of the sod. The area comprises to-day approximately not more than seven acres.

The *east side division* of meadows comprises an area of about 9.6 acres. The entire field to 1886 consisted of old, worn-out grass lands, overrun with a worthless growth on its more elevated portion, and covered with weeds and sedges in its lower section. The improvement of the land by underdraining and ploughing, and subsequently by the use of a system of drill culture, began in some parts (north end) in 1886 and in others (south end) in 1887. For the details of this work see ninth annual report (1891). The following seeds have been applied: —

In 1888, to the more elevated portions —

Two bushels herds grass (*Phleum pratense*).
Two bushels red top (*Agrostis vulgaris*).
Two bushels Kentucky blue-grass (*Poa pratensis*).
Two bushels meadow fescue (*Festuca pratensis*).
Seven pounds sweet-scented vernal grass (*Anthoxanthum odoratum*).

This was applied at the rate of from two to two and one-half bushels per acre. The lower and more wet portion of the meadow was seeded down with the following mixture of grass seeds: —

Twenty pounds soft brome grass (*Bromus mollis*).
Twelve pounds herds grass (*Phleum pratense*).
Nine pounds red fescue (*Festuca rubra*).
Eight pounds fowl meadow grass (*Poa serotina*).
Seven pounds Rhode Island bent (*Agrostis alba*).
Six pounds orchard grass (*Dactylis glomerata*).
Five pounds crested dog-tail (*Cynosurus cristatus*).
Four pounds meadow soft grass (*Holcus lanatus*).
Two pounds sweet-scented vernal grass (*Anthoxanthum odoratum*).

In 1889, from four to five pounds of alsike clover per acre were added by broadcast seeding to the meadow early in the spring.

In 1890, from two to three pounds of alsike clover seed were sown per acre on the entire meadow.

In 1892 the entire area was divided into four plats, numbered I., II., III., IV., beginning at the north end. The following system of manuring was adopted: —

Plat I. (1.95 acres), 31,200 pounds barn-yard manure, applied late in the fall of 1891 (rate of 8 tons to the acre).

Plat II. (2.02 acres), 24,240 pounds barn-yard manure, applied March 4, 1892 (rate of 6 tons to the acre).

Plate III. (2.59 acres), 1,554 pounds ground bone, 518 pounds muriate of potash, applied April 18, 1892 (rate of 600 pounds bone and 200 pounds muriate of potash per acre).

Plat IV. (3 acres), 3 tons unleached wood ashes, applied April 15, 1892 (rate of 1 ton to the acre).

Following is the yield of hay (first and second cut) for three consecutive years: —

Yield of Hay in 1890.

PLAT I.	First Cut.	Second Cut.
1.92 acres, . .	14,625 pounds, July 1.	3,790 pounds, Sept. 1.

Total yield of hay, 18,415 pounds.
Yield per acre, 9,591 pounds, or 4.80 tons.

Yield of Hay in 1890 — Concluded.

Plat II.	First Cut.	Second Cut.
1.92 acres, . .	12,480 pounds, July 1.	3,105 pounds, Sept. 3.

Total yield of hay, 15,585 pounds
Yield per acre, 8,117 pounds, or 4.06 tons.

Plat III.	First Cut.	Second Cut.
2.41 acres, . .	14,460 pounds, June 26.	3,535 pounds, September.

Total yield of hay, 17,995 pounds.
Yield per acre, 7,466 pounds, or 3.73 tons.

Plat IV. (IV. and V., **1889.**)	First Cut.	Second Cut.
3 acres, . . .	13,380 pounds, July 1.	4,080 pounds, Sept. 3.

Total yield of hay, 17,460 pounds.
Yield per acre, 5,820 pounds, or 2.91 tons.

Yield of Hay in 1891.

Plats.	First Cut.	Second Cut.	Total.
	Pounds.	Pounds.	Pounds.
Plat I., per acre, ...	6,528	1,446	7,974
Plat II., per acre, ...	5,988	1,440	7,428
Plat III., per acre, ...	4,641	1,015	5,656
Plat IV., per acre, ...	3,750	1,610	5,360

Yield of Hay in 1891 — Concluded.

Plats.	Total Yield.		Total Yield per Acre.	
	Tons.	Pounds.	Tons.	Pounds.
Plat I.,	7	1,549	3	1,974
Plat II.,	7	1,004	3	1,428
Plat III.,	7	649	2	1,656
Plat IV.,	8	80	2	1,360

Yield of Hay in 1892.

Plats.	First Cut.				Second Cut.			
	Total Weight.		Rate per Acre.		Total Weight.		Rate per Acre.	
	Tons.	Pounds.	Tons.	Pounds.	Tons.	Pounds.	Tons.	Pounds.
Plat I.,	5	805	2	1,541	2	45	1	74
Plat II.,	5	895	2	1,394	1	1,975	–	1,968
Plat III.,	6	50	2	652	1	1,320	–	1,282
Plat IV.,	6	1,087	2	362	3	110	1	36

Plats.	Total Yield.		Total Yield per Acre.	
	Tons.	Pounds.	Tons.	Pounds.
Plat I.,	7	850	3	1,615
Plat II.,	7	870	3	1,362
Plat III.,	7	1,370	2	1,934
Plat IV.,	9	1,197	3	398

Yield of Hay on West Side Division.

	Tons.	Pounds.
First cut,	9	510
Second cut,	3	25

Following is the analysis of hay and rowen grown on the plats : —

[I., hay; II., rowen.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	8.94	11.31
Dry matter,	91.06	88.69
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	6.64	6.48
" cellulose,	34.82	29.98
" fat,	3.18	4.23
" protein,	10.41	12.11
Non-nitrogenous extract matter,	44.95	47.20
	100.00	100.00

Fertilizing Constituents.

Moisture,	8.94	11.31
Nitrogen,	1.516	1.717
Phosphoric acid,	0.269*	0.432*
Potassium oxide,	1.55*	1.486*
Valuation per 2,000 pounds,	$6 24	$6 96

* Average in ninth report.

8. Report on General Farm Work (1892).

The lands assigned for the use of the Massachusetts State Agricultural Experiment Station cover an area of fifty acres. Ten acres are natural woodlands, and forty acres, including the space occupied by the buildings, are used for the raising of farm crops. At present from fifteen to sixteen acres are under cultivation, and from sixteen to seventeen acres are permanent grass lands. As every portion of the land is at present serving for some special experiment, the general management of the farm is to a controlling degree subjected to the requirements of the work called for in connection with the various questions under investigation. The adoption of a thorough mechanical preparation of the soil, supported by a careful, clean cultivation of the crops raised, has brought the lands into a fair condition for field experiments. Each field has had for years its own system of manuring, and becomes thereby from year to year more valuable for experimental purposes. Wherever circumstances have been favorable, forage crops have been chosen, for the purpose of studying the influence of various systems of fertilization and cultivation on their growth and special character. This practice has resulted already in the successful introduction of some valuable forage plants new to our locality, and has also materially assisted us in an economical support of quite extensive experiments in stock feeding. The beneficial effect of many of these crops on the physical and chemical condition of our cultivated lands is everywhere noticed, when compared with their previous general condition.

During the past season several varieties of soja bean, serradella, Canada peas and oats, summer vetch and oats have been raised, to supplement our current farm crops, as corn, rye, barley, Hungarian grass, etc., for feeding purposes.

Three silos have been filled with mixtures of different crops; one silo is filled with equal weights of fodder corn and soja bean, one with two parts soja bean and one part fodder corn, and the third with three parts serradella and one part Hungarian grass.

The character and amount of farm and garden crops raised in 1892 may be seen from the subsequent statement: —

	Tons.
Hay (first cut),	35
Rowen (second cut),	$11\frac{3}{4}$
Fodder corn (green),	$17\frac{1}{2}$
Corn stover,	$4\frac{3}{4}$
Corn (ears),	$\frac{3}{4}$
Roots (beets, $1\frac{1}{3}$; mangolds, $4\frac{3}{4}$; carrots, $2\frac{3}{4}$; turnips, $\frac{1}{4}$),	9
Rye (643 pounds grain, 1,767 pounds straw),	$1\frac{1}{5}$
Barley (539 pounds grain, 1,289 pounds straw),	$\frac{9}{10}$
Oats (318 pounds grain, 1,227 pounds straw),	$\frac{3}{4}$
Potatoes,	$3\frac{1}{5}$
Tomatoes,	$1\frac{1}{2}$
Cabbages,	3
Vetch and oats (green),	5
Vetch and oats (dry),	$\frac{1}{2}$
Soja bean (green),	10
Soja bean (straw, 770 pounds; beans, 240 pounds),	$\frac{1}{2}$
Canada peas and oats (green),	$1\frac{3}{4}$
Canada peas and oats (dry),	$\frac{3}{4}$
Miscellaneous crops,	$2\frac{1}{2}$

9. Department of Vegetable Physiology.

Report by Dr. James Ellis Humphrey.

As in previous years, the work of the department has steadily continued since the last report. The results of the year's investigations to be described in the following pages contain several matters of scientific interest and of practical importance to various classes of cultivators. The work on diseases of some leading winter crops has been continued, and a considerable part of the present report is occupied by a discussion of the known fungous diseases of the cucumber plant, both under glass and in the open air. Studies of a disease of English violets are described; as also some cultures of the "black-knot" fungus of the plum, with suggestions for its practical control. Directions for avoiding the attacks of the fungi known as powdery mildews will also be found, and briefer notes on other disease-producing fungi of importance.

The department has replied, during the year, to numerous inquiries from various sources touching a wide range of subjects, and has been able to be of considerable service to the farmers and gardeners of the State in this way.

In closing his connection with the station with the completion of this report, the writer desires to express the hope that the value of mycological investigations has been sufficiently demonstrated to ensure their continuation at Amherst.

The subject-matter of the present report is arranged under the following heads: —

I. Diseases of the cucumber plant.
   1. Sclerotium disease ("timber rot").
   2. Powdery mildew.
   3. Downy mildew.
   4. Damping off.
   5. Leaf blight.
   6. Leaf glaze.
   7. Other diseases.

II. A violet disease.
III. The black knot of plum and cherry.
IV. Grain rusts.
V. Various diseases.
  1. Powdery mildew of strawberry.
  2. Powdery mildew of gooseberry.
  3. Cluster cup of gooseberry.
  4. A hazel fungus.
VI. Treatment for powdery mildews.

As before, the "General Account of the Fungi," on pages 195 to 211 of the seventh report of this station, may be found useful as an aid to the full understanding of the following discussions.

I. Diseases of the Cucumber Plant.

1. A Sclerotium Disease — *Sclerotinia Libertiana* F'k'l (Plates I. and II.)

A subject concerning which many and urgent inquiries have been addressed to the writer by growers of winter cucumbers near Boston is the disease known among them as "timber rot."* This trouble makes its appearance regularly in the spring, when the plants are well grown and in bearing, and is a cause of much loss. The first specimens showing the nature and effects of the disease were received in May last, from W. W. Rawson, Esq., of Arlington; and subsequently a visit was made to his greenhouses, where the disease was seen in various stages of development, and further specimens for study were obtained.

The most cursory examination of good specimens makes it evident that we have here to do with a fungous disease of much interest. It attacks chiefly the stems of the host-plants, sometimes the fruits. I am not aware that it ever attacks this crop out of doors, but in the warm and moist atmosphere of the cucumber house the fungus finds very

* Concerning the origin of this name it is not easy to suggest an explanation. Popular names of diseases serious enough to attract attention are usually in some way descriptive or otherwise appropriate. The present name has little of such quality to recommend it, and I have no clue to its origin, unless the appearance of the fresh mycelial threads on the stem may have suggested that of the mycelium of *Merulius lachrymans* and other hymenomycetous species which attack wood.

congenial conditions for luxuriant development. The earliest external sign of the presence of the fungus to which the disease is due is commonly the appearance of dense white mats of its mycelium at and near the nodes of the stem (Pl. I., *a*). Examination shows that the tissues of the stem are thoroughly permeated by the fungus-threads, which have here burst through the surface. At this stage the stem is still green and plump (Pl. I., *a*), but as the disease progresses it begins to shrink (Pl. I., *b*) and to turn yellow. Later, its cellular tissue (parenchyma) undergoes what may be termed a sort of granular decay, shrivels, and finally dries up, leaving hardly more than a withered mummy of the original stem, consisting of the dried and yellow vascular bundles and epidermis (Pl. I., *c*).

In the interior of diseased stems may be found thick masses of white mycelium, and in the later stages there appear, especially near the nodes, hard, slender black bodies, sometimes of considerable size, which remain after the disappearance of the mycelium (Pl. II., fig. 1). These serve as a clue to the cause of the disease when only the dried skeleton of the stem remains. Sometimes similar black bodies are developed in the mycelial mats on the exterior of the stems (Pl. I., *d*), but this is not commonly the case. Where it does occur, these bodies, instead of being slender and spindle-shaped, are usually rounded or irregular in outline, and more or less flattened. In either form they are at once recognizable as the characteristic resting stage of certain fungi, known as *sclerotia*, and point strongly to the probability that the disease is due to one of the parasitic cup-fungi (*Discomycetes*) of the genus *Sclerotinia*. The young fruits are often attacked by the fungus, becoming soft and watery, and their surfaces being covered by the white mycelium. The rounded and flattened sclerotia are usually quite freely developed on the rotted fruits (Pl. I., *fr.*), and are often found adhering to their shrunken remnants. Sometimes two or more sclerotia of the surface form arise so close together as to become united into an irregular mass (fig. 2).

These sclerotia arise from masses of fungus-threads which

become closely intertwined, branching and increasing in size until a compact structure is formed. This is at first white, but its outer layers soon become changed, and their cell walls thickened and blackened to form a protective rind about the inner unchanged parts. A section through the inner portion of a mature sclerotium shows that the constituent threads have become so closely compacted that they form a firm pseudoparenchyma (fig. 6). As they lie in all directions, any section is sure to follow the course of some of the threads, while others are cut at all angles. Thus the apparent cells of the pseudoparenchyma vary in outline from circular to much elongated. The cell cavities have abundant protoplasmic contents, but neither starch nor oil can be recognized in them. When sections are submitted to Errera's iodine test, however, they prove to be very rich in glycogen, which doubtless serves as a reserve food material for the future development of the sclerotia. These bodies are to be regarded, then, as resting mycelia, which serve the same purpose as the resting spores of some fungi in tiding over periods unfavorable to active development, and thus keeping alive the species from season to season.

In order to learn the history of their further development, a number of sclerotia were placed in moist chambers May 26, a part on rather poor soil and a part on pure quartz sand. Both lots were kept about equally damp, and stood side by side in a north window; but those on the sand began their "germination" more promptly and carried it through more satisfactorily. As those on the soil gave no results different from the others, and were subsequently transferred to sand, where they did much better, they will be neglected in the following account. But it should be said that this result was to be expected under the very artificial conditions of the culture chamber, and cannot be held to be equally applicable to the greenhouse. In a month one of the sclerotia on quartz sand showed signs of further development. Two slender stalks were growing upward from its upper side, and two others were just breaking through its lower surface. This would indicate that the points of origin of these stalks are not determined by the amount of light to which they are

exposed. The rate of growth of the stalks may be indicated by the fact that two which were five millimeters long June 28 (fig. 3) had become nine millimeters long July 8, ten days later. Two months after the beginning of the culture several sclerotia showed from one to four stalks each, some of them well developed. These stalks are bundles of nearly parallel threads, arising from the inner tissue of the sclerotium and bursting through the rind. They are at first white, except for a short distance above their bases, and their sides are clothed by the short and delicate free ends of some of the outer threads. If they assume an erect position from the first, their basal portions are only slightly dark colored (figs. 3 and 7); but if, as often happens, they grow for a time beneath the surface of the sand or soil, these portions may have hardened and blackened surfaces (fig. 5). These stalks, or their aerial portions, are very sensitive to light. In cultures before a window the young stalks grew from the first strongly toward the window. When the culture chamber was turned through 180°, so as to make them point away from the window, they very promptly responded to the stimulus of the light, and in a single day showed strong heliotropic curvature. In two or at most three days they had bent sharply upon themselves, and were again directing their tips obliquely toward the light, in response to the combined influences of negative geotropism and positive heliotropism. By the time a stalk reaches a length of about five millimeters above the surface of the sclerotium or of the soil, a conical depression begins to appear in its upper end (fig. 7). This depression arises and increases in size by greater growth at the circumference than at the centre of the stalk, and the final result is a shallow cup crowning the stalk. Some idea of the rate of growth of these cups may be gained by comparing the stages *a* and *b* in figs. 4 and 5, in each of which the condition shown at *b* represents the gain in four days over *a*. Under favorable conditions the cups may reach a diameter of as much as eight millimeters, and they have been been even larger. Ordinarily, when they become larger they are also much flattened, having often the form of disks, with only slight depressions at their centres. When mature,

their outer surfaces remain of a white or slightly creamy color, while their inner or upper faces are of a brownish or clay-colored shade.

While still very young the cups may be seen to be the spore-producing organs of the fungus. The body of a cup is composed of threads, which are continuations of and similar to those of the stalk; but its inner surface is composed of two kinds of threads, arising from the vegetative threads of the outer portion and standing close together parallel to each other and at right angles to the surface, like the threads of the "pile" of velvet. A part of these threads are essentially similar to those from which they arise, and these terminate in blunt ends. They are known as *paraphyses*. The rest are much swollen, and when young have dense protoplasmic contents. As they reach their full size the contents begin to show differentiation, and there finally appear in each of these spore-sacs eight colorless, elliptical spores (fig. 8). When the spores are quite mature, one may observe that the tip of the spore-sac (*ascus*) appears thickened and gelatinous. It is through this apical part of the wall that the spores are discharged; and after their escape one may see the opening through which they have passed out. The ejection of the spores from an ascus takes place suddenly and explosively, and, as the tips of the asci form the inner surface of the cup, they pass directly into the air. If a cup be allowed to develop quite undisturbed in a moist chamber for two or three days, and then be slightly jarred, the escape of the spores from the numerous asci that have ripened during the interval can be plainly seen, like a tiny puff of white smoke from the surface of the cup. If a glass slip, moistened with water, be held over the cup when this occurs, the spores (fig. 8, *sp.*) can be obtained very pure and in considerable quantity. As has been said, the asci and spores begin to mature when the cup is still very small, and the ripening of successive ones continues during and after the close of the growth of the cup, for a period of three weeks or more. During this time the number of spores produced by a single cup is enormous, and quite beyond approximate estimations. In my cultures

of a few sclerotia produced on a single young fruit (Pl. I., *fr.*), they continued to give rise to successive new cups for a period of four months.

A comparison of the structures which have been described with the recorded facts concerning the known *Sclerotiniæ* shows that in the form and structure of the sclerotia, in the color, form and size of the cups, and in the form and size of the spores, this fungus fully agrees with the European species known as *Sclerotinia Libertiana* F'k'l., and described by Brefeld * and DeBary † under the name *Peziza Sclerotiorum.* Our first cultures with this fungus were made immediately after obtaining the material, with the only parts of the plant then available, mycelium taken from diseased cucumber stems, and sclerotia. On prune-gelatine a small bit from a mass of mycelium gave rise to abundant threads, ramifying through the substratum, and producing abundantly the "attachment organs," to be described later, but giving rise neither to sclerotia nor to any spore form. Thin slices from the inner tissue of sclerotia sown on the same substratum gave the same result. But when similar slices were sown on sterilized bread, saturated with an infusion of prunes, the bread became completely enveloped in a white mycelial cloud. A week after the beginning of the culture the mycelium had collapsed into a thick film over the surface of the bread, and a few rather small sclerotia had formed on the surface. Two weeks later, no further change having been observable and all development having evidently ceased some time before, the whole was removed from the moist chamber, and it was found that beneath the superficial mycelial film, and occupying the space originally occupied by the substance of the bread, was an almost solid mass of well-matured sclerotia, varying in size from that of small shot to that of a large pea.

We may consider next the cultures with ascospores made after the development of the spore cups from the sclerotia afforded the means of obtaining them. When these spores are sown in distilled water and protected from drying up, they germinate promptly and show considerable growth by

* Botanische Untersuchungen über Schimmelpilze, IV.: 1881.
† Botanische Zeitung, 1886, Nos. 22–27.

the end of the first day (fig. 9). They may continue to grow for about two days, in which time the germ tube may become several times as long as the greater diameter of the spore. If no nourishment be obtainable, growth ceases and death follows. If, however, nourishment be provided in the form of an infusion of prunes, for instance, the development of the germ thread is very rapid, and the entire culture drop is filled by a mat of strong and branching threads. The difference in development due to absence or presence of nourishment may be seen by comparing figs. 9 and 10, which represent spores after one day's development under these opposite conditions, respectively. Vigorous branches of the mycelium grow upward into the air and downward into contact with the glass slip supporting the culture. No traces of spore formation could ever be detected on the aerial threads, although carefully sought for. On the branches which come in contact with the glass are produced in all nourished cultures, and very abundantly, certain structures characteristic of this and related species of fungi, and known as *attachment organs*. These organs appear to be formed whenever branches of a growing mycelium come in contact with firm unyielding objects. They are produced by the rapid and more or less exactly dichotomous branching of a thread, which, at the same time, becomes much stouter and richer in protoplasmic contents than before. The short and densely aggregated branches form a thick tassel, which becomes attached by the free ends of its branches to the substratum (fig. 11). At this time these organs are readily recognized by the naked eye as small darker spots on the glass of the culture slip or vessel. A day after its complete development one of these organs shows signs of degeneration. Its dense contents begin to become watery and to disappear, and by the second day there is left little but the empty outer walls, enclosing a nearly or quite continuous cavity (fig. 12). The possible or probable significance of these peculiar structures may be discussed later. Slide cultures of spores in prune infusion or similar fluid medium rarely yielded anything besides mycelium and attachment organs; but occasionally a small sclerotium is developed. The vegetative development on

any nutrient substratum is accompanied by a remarkable formation of the octahedral crystals of oxalate of lime, which are produced in immense numbers in the interstices between the threads.

Ascospores sown on sterilized bread saturated with an infusion of prunes, in test tubes, produced an abundant and beautiful mycelium over the whole surface of the bread and far above it. The branches in many places reached the inner surface of the tubes, and there developed great numbers of attachment organs. No spore formation ever occurred; but a week after the beginning of the culture dense white masses were detected among the looser threads. On examination these proved to be very firm lumps of matted threads; and the following day they had become nearly black in color. A day later, nine days from the sowing of the spores, the cultures contained many larger and structurally mature sclerotia. In this case the sclerotia were produced wholly upon the surface, and did not replace at all the substance of the bread, as in a previously described instance. Subsequent examination showed that no further development occurred, the activity of the mycelium ceasing with the formation of the sclerotia.

If ascospores be sown in water on the surface of a cucumber stem, or at its growing point, it might be expected that the germ tubes would promptly penetrate the tissues and infect the plant, if it be really true that this fungus is the efficient cause of the disease. But, although carefully protected from drying, they utterly fail to attack the plant, even though sown in a fresh cut reaching to the active tissues of the plant, when sown in water only. On the other hand, if they be sown on a healthy and uninjured part of the plant, in a drop of nutrient fluid, the result is very different. Germination proceeds rapidly, attachment organs are formed on the surface of the plant, and soon this surface is penetrated by fungus-threads which quickly spread through the tissues. In this way infection takes place, and the plant is lost. Even the leaves of a plant kept in a moist chamber are in this way readily attacked. Three days from the sowing of a small drop of prune infusion containing fresh ascospores upon a large leaf of such a plant, the leaf was a

slimy mass of decay, while a neighboring one, sown with spores in pure water at the same time, remained perfectly sound. Two days later the whole plant had succumbed. If a bit of decayed tissue, containing abundant and vigorous threads of the fungus, be placed upon a healthy plant, the latter is promptly attacked and destroyed. These results furnish interesting confirmation of DeBary's conclusion* that the spores of this fungus are unable to attack its host-plants parasitically until their germ tubes have been saprophytically nourished for a time. That is, the fungus may be said to be in process of acquiring a truly parasitic habit which it has not yet fully developed. There is no reason to doubt that these spores, germinating on the rich soil of the greenhouse, about the bases of the plants, find there all the nourishment needed for the development of a mycelium capable of parasitic invasion. It seems very probable, too, that DeBary's explanation* of the significance and function of the so-called attachment organs is the correct one. This is to the effect that these organs, developed on the firm surface of the host from the saprophytically nourished mycelium, produce in the fluid which results from the breaking down of their protoplasm, previously described, some substance which softens the cell walls and kills the cell contents of the host. The fungus-threads are then able to attack these dead cells, and thence to penetrate farther and farther into the tissues of the host-plant. After its establishment, and the development of an abundant mycelium within the host, the fungus forms its sclerōtia just as in the cultures above described, their form being somewhat modified by the shape of the cavity when they develop in the inner spaces of the plant.

We pass now to consider the question of other spore forms of this fungus. It is a well-known fact that many Ascomycetous fungi possess one or more secondary "summer spore" forms, known as conidia, pycnidia, etc.; and some such forms have been found to belong to those species of fungi most closely related to the present one. None has, however, been heretofore proved to belong to the present species. Therefore, when, in examining plants in Mr. Raw-

* Botanische Zeitung, 1886, Nos. 22-27.

son's greenhouse, a young rotting cucumber was found which bore, besides the white *Sclerotinia* mycelium, the dark spore threads and abundant spores of a *Botrytis* form, the question of its genetic connection with the *Sclerotinia* became a very interesting one. The specimen was carefully preserved, and the spores were obtained quite pure for a series of cultures. When sown on prune-gelatine they produced a luxuriant mycelium, whose growth was accompanied by a characteristic formation of crystals of oxalate of lime. From this mycelium were developed numerous attachment organs, like those above described, and spore threads, with spores, identical with the original *Botrytis* form. Except for its physiological similarity in the production of oxalate of lime and the structural similarity of its attachment organs, there was no ground for suspecting any connection between this form and the *Sclerotinia*. Sown on bread saturated with prune infusion, the original spores gave results precisely similar to those above described. When sown on a solid block of sterilized potato in a test tube, however, they produced not only abundant attachment organs and spore threads, but also sclerotia. Nine days after the beginning of a culture, very dense masses of mycelium were seen at the angles of the block of potato, and two days later well-formed young sclerotial masses occupied the same positions. These matured fully, and showed, in their microscopic structure and in their reaction for glycogen, complete identity with the sclerotia developed from the ascospores of the *Sclerotinia*. The sclerotial masses did not form a rind on the side next to the potato, and remained closely adhering to it; but this was probably due merely to the character of the substratum. It is of interest to note that the spores of the second generation from the original material failed to produce sclerotia on any of the substrata mentioned; but the positive evidence of a single culture is worth any number of failures. There is no possibility of the contamination of the successful cultures by ascospores, for at the time they were made not a single *Sclerotinia* cup was or ever had been in existence in the laboratory. The culture was made with a drop of distilled water containing a few spores, and showed no evidence of the presence of any other mycelium or spore form than

the *Botrytis*. I have preserved the block of potato with *Botrytis* threads and sclerotia as evidence of the correctness of these statements. It is, I believe, quite within bounds to say that the results described raise a very strong presumption in favor of the view that *Sclerotinia Libertiana* possesses a conidial stage of the *Botrytis* type. This view is further strengthened by the observations to the same effect made in the study of a disease of rape by Frank,* although he identified his *Botrytis* as one which is known to be connected with another species of *Sclerotinia*.

As to the identity of the *Botrytis* in question, the indefiniteness of the descriptions of the various so-called species, and the undoubted multiplication of specific names beyond all reason, render it difficult to speak with certainty. But the form on the cucumber appears to me to be identical in all respects with that previously described † as the cause of the rotting of lettuce in the greenhouse, and believed to be the form known as *Botrytis vulgaris* Fries. Some points of its structure are poorly shown in fig. 13. Unfortunately, I was not able to make infection experiments when living spore material was available; but, in view of Kissling's results ‡ with a closely related *Botrytis*, it seems probable that the conditions which govern its attacks as a parasite are similar to those above described for the ascosporic form.

Consideration of the life history above sketched shows clearly that the key to the situation, so far as the control of this disease is concerned, is to be found in the destruction of the sclerotia. If plants which show the disease be promptly removed and destroyed, and the development of sclerotia be thus prevented, while careful watch is kept for any sclerotia accidentally allowed to form, one need have little fear of serious loss in future crops, even on the same soil. It is only where diseased plants are neglected, and sclerotia are allowed to develop and fall to the ground to serve as sources of infection for the next crop, that serious attacks can continue from season to season. The control of this disease does not require even the trouble of spraying, but

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* Die Krankheiten der Pflanzen, p. 530: 1880.

† Ninth Report Massachusetts Experiment Station, p. 219.

‡ Hedwigia, 1889, p. 227.

merely the practice of what should be ruling principles in every greenhouse, *cleanliness* and *watchfulness*.

In conclusion, it may be of interest to review briefly the known parasitic species of *Sclerotinia*. We need notice only those which are capable of really parasitic life, and are thus truly disease-producing fungi. *Sclerotinia Libertiana* F'k'l., the above-described species, was one of the earliest studies. Our first exact knowledge of it is due to DeBary,* Brefeld † and Mattirolo,‡ who described the sclerotia and the perfect form, while later DeBary § worked out the very interesting conditions on which its parasitic life depends. He cultivated it on a great variety of plants, including the turnip, beet, carrot, radish, potato, petunia, zinnia, bean and others. Brefeld found it attacking the Jerusalem artichoke, and Frank ‖ observed a disease of rape produced by it. It is probable, too, that the disease of hemp observed by Tichomiroff ¶ in Russia is due to the same species. The cucumber has been found by Smith ** to be attacked by a fungus which he identified as *Botrytis vulgaris*, but which he regarded as only a saprophyte. It was probably the conidial stage of this *Sclerotinia*, and the discovery of its perfect form on the same host is therefore very natural. Many additions to the list of its host-plants are likely to be made.

Sclerotinia Fuckeliana DeBary is one of the best known of these forms. It attacks especially the leaves and fruits of the grape vine in Europe, and is found on the herbaceous parts of various plants, chiefly in its conidial form, known as *Botrytis cinerea*. Although, as in *Scl. Libertiana*, the conidial form usually reproduces itself persistently, the sclerotia give rise under favorable conditions, when just matured, to the *Botrytis* form. When older, they produce the spore cups of the perfect form. These facts make the demonstration of the connection of the two forms much easier than in *Scl. Libertiana*. A disease of onions de-

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* Morphologie and Physiologie der Pilze, pp. 35, 60, 201 : 1866.
† Botan. Unters. über Schimmelpilze, IV., p. 112 : 1881.
‡ Nuovo Giornale Botanico Italiano, XIV., 200 : 1882.
§ Botanische Zeitung, 1886, Nos. 22–27.
‖ Die Krankheiten der Pflanzen, p. 530 : 1880.
¶ Bulletin Soc. Naturalistes de Moscou : 1868.
** Gardeners' Chronicle, XXV., p. 173 : 1876.

scribed by Sorauer* appears to be due to this species. Its conidial form has been the subject of important studies by Klein,† Müller-Thurgau ‡ and Kissling.§

Sclerotinia Trifoliorum Eriks. has been shown by Kühn,‖ Rehm ¶ and Ericksson ** to cause a serious disease of various species of clover. No conidial form has yet been connected with it. From Wakker's †† account it would seem that a very destructive disease of various bulbs (hyacinth, narcissus, crocus, scilla, etc.) in the great propagating fields of Holland is due to the same fungus. On either of its host-plants it penetrates and destroys the tissues rapidly, leaving finally only their shrivelled remains.

A disease of the European whortleberry was described by Schroeter ‡‡ in 1879, and by him attributed to one of these fungi, which he called *Peziza baccarum*. The subject was taken up later by Woronin, who has distinguished §§ four closely related species that attack the fruits and leaves of European *Vaccinia*. The one which he has studied in most detail is *Sclerotinia Vaccinii* Woron. This species has a summer spore form, not of the *Botrytis* type, but very similar to our common fruit-rot fungus, *Monilia fructigena*.‖‖ There is no reason why these or similar species may not be found attacking our American blueberries or cranberries, and producing the "white blueberries," so often regarded, and sometimes justly, as freaks or sports.

Finally, there may be mentioned, as of interest in this connection, the disease of garden lilies studied by Marshall Ward,¶¶ and shown to be due to a *Botrytis* apparently distinct from those above mentioned, and very probably the conidial stage of an unidentified *Sclerotinia*.

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* Handbuch der Planzenkrankheiten, II., p. 294: 1886.

† Botanische Zeitung, 1885.

‡ Landwirthschaftliche Jahrbücher, XVII., p. 83: 1888.

§ Hedwigia, XXVIII., p. 227: 1889.

‖ Hedwigia, IX., p. 50: 1870.

¶ Entwickelung eines Kleearten zerstör. Pilzes; Göttingen, 1872.

** Kgl. Landsbr. Akad. Handlingar: 1880. See Bot. Centralbl., I., 296.

†† Allgem. Vereen. voor Bloembollencultur te Haarlem, 1883-4; and Archiv Neerlandaises, XXIII.

‡‡ Hedwigia, XVIII., p. 177: 1879.

§§ Mém. Acad. Sci. St. Petersburg, Sér. 7, t. XXXVI.: 1888; and Bericht. Deutschen Bot. Gesellschaft, III., p. LIX.: 1885.

‖‖ Eighth Report Massachusetts Experiment Station, p. 213; and Pl. II.

¶¶ Annals of Botany, II., p. 319: 1888.

2. The Powdery Mildew. — *Erysiphe Cichoracearum* DC. (Plate III.)

In the last report of this department* an account was given of this disease, which was then described for the first time in America. No new facts concerning it have since been learned; but as drawings intended to accompany that account were unfortunately lost in the mail, new ones have been prepared for publication in the present report, and a brief recapitulation of some facts concerning it may serve to explain these figures to those who have not the previous report at hand.

Like all the powdery mildews, this plant is a surface parasite, its vegetative threads running over the exterior of the host (fig. 14). The epidermal cells of the latter are pierced at intervals by short, thick branches, sent downward from the vegetative threads, whose office is the absorption of nourishment for the fungus from the invaded host cells (fig. 14, *h*). From the vegetative threads are also produced erect spore threads (fig. 14, *sp.*), which bear the summer spores of the fungus. These are cut off in basipetal succession by cross partitions, the apical spore being thus always the oldest and falling from the chain as soon as it is fully ripe (fig. 15). These ripe summer spores (fig. 16) germinate quickly, and serve to spread the fungus rapidly. The fact was mentioned in our previous report that the spores on diseased cucumber leaves, received from Fitchburg, Mass., and from Ithaca, N. Y., respectively, did not fully correspond in size and form, and may possibly represent different species of fungi. Their differences may be seen by comparing the figures given. While all the other figures are taken from the Massachusetts form, fig. 17 represents the larger summer spores of the New York one.

Before the publication of the previous account of this fungus, only its summer spore form was known on the cucumber, and its specific identity, which depends upon the winter stage, was therefore undetermined. The appearance of the winter form in our greenhouse has made this identification possible, and has shown that the Massachusetts form,

* Ninth Report Massachusetts Experiment Station, p. 222.

at least, is one of the most common and widely spread members of the group *Erysiphe Cichoracearum.* The winter stage consists of tiny, dark-brown, rounded capsules, consisting of a firm outer crust of compacted cells, enclosing a group of spore sacs. Within these sacs, when mature, are formed the spores. The structure of the perithecia, asci, spores and haustoria of the cucumber fungus identifies it beyond doubt as the species above named. I have not been able to duplicate the lost drawings of a perithecium, but fig. 18 shows a group of characteristic asci with spores, and fig. 19 a single ripe spore. These spores undoubtedly carry the fungus over from season to season, but nothing is yet known as to their germination and further development.

3. THE DOWNY MILDEW.—*Plasmopara Cubensis* (B. & C.) Humph

In a previous report of this station* will be found an account, with figures, of this downy mildew of cucurbitaceous plants, which, though but recently recognized in this country, has come to be a serious pest. So far as I know, its occurrence on the cucumber plant in the greenhouse has not heretofore been mentioned, though it has often been observed in the open air and in the hot-bed. This fungus was received about October 1, in large quantity, on leaves of greenhouse cucumbers, from Messrs. C. H. Chase & Son of Clinton, who report that they have suffered from its attacks for two years previous to the present. On leaves attacked by this fungus, it is not commonly sufficiently abundant to be recognized by the unaided eye, as the spore threads are rather thinly scattered over the lower faces of the leaves. But on the material above mentioned the development of the fungus was very luxuriant, perhaps from the peculiarly favorable conditions afforded by the greenhouse. The lower leaf surfaces showed the distinctly purplish tint, due to the abundant development of summer spores, which characterizes the presence of various nearly related fungi on other hosts. These individuals presented no differences in structure from those developed out of doors, but the difference in luxuriance of development was very striking.

* Eighth Report Massachusetts Experiment Station, p. 210, and Pl. II.

This parasite is very destructive under favorable conditions, but there is no reason to doubt that thorough and timely spraying will control it, at least where the host-plants are otherwise in a condition to make healthy growth.

4. Damping Off. — *Pythium DeBaryanum* Hesse.

Seeding plants of many species have long been known to be destroyed in great numbers by the affection known as "damping off." To the number of those known to be thus affected was added in a previous report* the cucumber plant, and the cause of the trouble was shown to be the same fungus to which it is commonly due in Europe. The same fungus has repeatedly been met with in the cucumber house during the past two years, and has caused much loss of time and of plants. Last fall seedlings which had started well in a bed of fresh, rich soil, just taken from a compost heap where it had lain for at least two years, were so generally attacked that nearly all were lost. The attacks were so nearly simultaneous that there can be no doubt that the fungus was generally diffused throughout the soil; and, unless it is able to propagate itself in some way of which we now know nothing, the spores from which the infection originated must have remained alive in the compost for a long time. Unfortunately, no practicable treatment can be recommended beyond the removal of affected seedlings, with the surrounding soil, as quickly as possible after they show the presence of the fungus.

5. The Leaf Blight. — *Cladosporium cucumerinum* Ell. & Arth. (Plate IV.)

Early in October we received from Messrs. C. H. Chase & Son of Clinton some cucumber plants whose stems and roots were quite healthy, while the leaves were badly wilted, and had a peculiar watery appearance. Everything indicated that here was a definite disease, as leaves on a given plant showed various stages in its progress, those in the latest stages being reduced to a mass of decaying tissue, while those in the earliest stages were just beginning to wilt and to show translucent watery spots. The senders

* Eighth Report Massachusetts Experiment Station, p. 220, and Pl. II.

reported the trouble as one quite new to them. They stated that it may show itself on any part of the plant and spread rapidly over the whole, so that all the leaves are practically destroyed in two or three days. In spreading from plant to plant, they observe, it seems somewhat erratic, attacking one here and another there, without order, but eventually taking all in the bench. It will be seen that this is a very serious affection where conditions favor, and one of much importance, from the extent of its ravages and the rapidity with which it does its work.

It was impossible to recognize the presence of any fungus with the unaided eye, and the fact of such presence was at first doubted. But microscopic examination demonstrated the presence on all diseased leaves, even in the earliest stages, of the mycelium and spore threads of a fungus of the imperfect form germs *Cladosporium*. The mycelium of the fungus (figs. 25 and 26, *m*) grows freely within the leaf tissue, and after it is well developed sends branches to the surface through the pores (*stomata*) of the lower surface of the leaf. Frequently several of these threads come to the surface through a single pore. Just at the mouth of the pore there is usually formed a closely packed mass of small cells, which originates from the threads, but whose precise development I have not followed. This may be called the *byphal knot* (fig. 26, *a*), and is ordinarily large enough to conceal, nearly or wholly, the guard cells of the pore. From this knot arises a cluster of few or several erect spore threads (fig. 25). These threads, at first simple, may remain so indefinitely, cutting off the simple spores (fig. 25, *sp.*) from their ends; or they may branch, producing at their ends short cells with all the characteristics of spores, which may remain attached to the threads and undergo further development. This results in the most highly complicated form of the spore threads, and consists in the successive acropetal production of sprout buds from the originally terminal joints, so that there are formed chains of successively smaller and smaller cells, producing a much branched and very complex appearance (fig. 26). All the cells thus produced appear to be functional spores, and the rapid spread of the disease in the greenhouse shows how promptly they are capable of

germinating and infecting fresh tissues. Unfortunately, I had no suitable plants for infection at the time the material was received; but a careful study of the various stages of the disease presented by the different leaves of a plant affords little room for doubt that this fungus form is its efficient cause.

The only mention of a disease of this host caused by a similar fungus that has come to notice is that by Arthur,* who has described the development of decayed spots on cucumber fruits, observed by him in New York and Indiana. In this case the cause of the decay, which was a source of much loss, appeared to be a *Cladosporium* form, which the writer called *Cladosporium cucumerinum* Ell. & Arth. It is impossible to say that our leaf-destroying form is the same as this which attacks the fruits, but there is no reason for assuming them to be different. On the other hand, it is by no means certain that either the leaf or the fruit form is distinct from forms previously known on other hosts. Indeed, the accumulation of evidence that the common form known as *Clad. herbarum*, until very recently regarded as only saprophytic, is capable of actively parasitic life, must weaken one's doubt that most of the related forms possess the same capacity. Our knowledge of the *Cladosporium* forms is very fragmentary, and there can be no doubt that a thorough study, based on detailed cultures of the various forms, would result in a great reduction in the number of so-called species. For the present, then, our parasite may bear the name given by Ellis and Arthur, in the sense that it is a *Cladosporium*, attacking cucumber plants, without any necessary implication as to its real distinctness from forms attacking other host-plants.

It seems altogether probable that prompt spraying as soon as this disease begins to appear will prevent its spread to healthy plants. But, in view of its rapid progress, a very little delay may be fatal.

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* Sixth Report New York Experiment Station, p. 316, 1888; and Nineteenth Bull. Indiana Station, 1889.

6. The Leaf Glaze. — *Acremonium* sp. (Plate IV.)

Early in 1891 cucumber leaves were received from Fitchburg, Mass., whose lower surfaces showed delicate glairy films of fungus-threads, as described in our last report.* These leaves came from very badly diseased plants, which had received no benefit from the application of fungicides, although it seemed probable that the accompanying fungus bore some causal relation to the trouble. The fungus-threads on the leaves were quite sterile when received, but, when the leaf bearing them had lain two or three days in the moist chamber, produced spores abundantly. Drawings showing the structure of the fungus and the germination of its spores were made at the time and laid aside, in the hope that additional material would make possible an extension of our knowledge of the disease and of the relations of the fungus in question to it. As it has not again been met with, no further information can be given concerning it, and we can only complete the record of our meagre knowledge of the subject by publishing herewith the drawings mentioned.

The film on the leaves consists of numerous delicate, colorless and closely interwoven threads. These give rise in the moist chamber, and probably sooner or later under natural conditions, to short simple threads at right angles (fig. 27), at the slightly knobbed apex of each of which is produced a single somewhat kidney-shaped spore (fig. 28). In water these spores swell up and produce stout germ tubes of considerable length, similar to the original threads of the film (fig. 29). This is all we know of the fungus. It is to be hoped that some investigator may be able to study it in detail, with the disease it accompanies, and to answer the many interesting questions concerning it which still await an answer.

7. Other Diseases.

Two other diseases of some importance, which have not yet been observed in Massachusetts, but may at any time be met with, may be briefly mentioned in conclusion.

Halsted has described † a serious rotting of cucumbers and

* Ninth Report Massachusetts Experiment Station, p. 227.

† Botanical Gazette, 1891, p. 303; and Twelfth Report New Jersey Station, p. 273.

other cucurbitaceous fruits, which is accompanied by and seems to be due to a form of *Bacterium*. It appears to be readily communicated by inoculation, and sometimes causes very serious and rapid loss.

At various times and in various places the fruits, and sometimes stems and leaves, of the cucumber have been observed* to be attacked by a disease of the type now generally termed anthracnose, produced by some of the fungus forms included under the name *Glœosporium*. The forms have been called by different names by different writers, and it may be doubted whether they are all identical. Some of them appear capable, under some conditions, of great destructiveness. Nothing is known as to the perfect forms of the fungi in whose life cycles they constitute stages.

II. A Violet Disease. — *Phyllosticta Violæ* Desm.

In the summer of 1891 my attention was called by W. D. Philbrick, Esq., of Newton Centre, to a disease of cultivated violets (*Viola odorata*), from which he and other growers had suffered severely for several years. A visit to his and neighboring grounds showed the plants, at that time growing in the field, to be badly attacked. The leaves showed very numerous circular whitish spots, averaging about an eighth of an inch in diameter. In many instances these spots had run together, and in the worst cases whole leaves were covered by the spots and involved in a general decay. From the parts of the field where the trouble was most serious there arose an almost sickening odor of decay, and here nearly every plant was badly affected. It was very noticeable that the most commonly grown variety, the Marie Louise, was the greatest sufferer, while the double Russian, with its stockier foliage, was far less attacked, and the single Russian least of all. Another striking fact, and one which one would hardly expect to be a fact concerning a fungous disease, is that plants growing in the shade of a tree and so protected by it as to be still wet with dew in the afternoon were the healthiest in the field, and showed hardly a trace of disease. The impression made by an inspection of the

* Gardeners' Chronicle, 1876: V., pp. 438 and 505; VI., pp. 175, 269, 303, 336, 370, 400, 495. First Report Insect and Fungous Pests of Queensland, p. 175: 1889.

fields was very decidedly in favor of the supposition that the trouble in question was a disease of the leaves, due to the organism causing the spots.

Close inspection of the spots showed tiny black pustules on each; and these proved to be the conceptacles or spore fruits of the fungus, whose development in the leaves causes the death of their tissue in certain regions, and thus produces the spots. The conceptacles appear to belong to that fungus form known as *Phyllosticta Violæ* Desm. It is one of the so-called "imperfect fungi," whose perfect or winter-spore form and other summer-spore forms have not yet been determined.

In the fall of 1891 both healthy and diseased plants were received from Mr. Philbrick, and were set in a bench and in a box in the greenhouse. Those which were diseased when sent did not become established so readily as the others, and, although they lived for a time, they eventually succumbed and other diseased plants were set in their places. These met the same fate. Plants with dead or dying foliage were several times removed and carefully examined throughout. In some cases the roots appeared perfectly healthy, but in others there were plainly found the characteristic root galls produced on many plants by a *Nematode* worm. These were, however, abundant in no instance, and the roots were never sufficiently involved to account for the death of the plant.

With a thought of the possibility of a complication of the fungous trouble by some other affection, Mr. Philbrick had been asked to watch carefully for any abnormal appearance of the roots, and especially for any root galls, when transplanting his violets from the field to the greenhouse. He reported that, among three thousand plants, the roots of all but six seemed quite healthy. These six plants were sent to the station, and were found to bear the familiar *Nematode* galls in small numbers. Four of the affected plants were set in a box and submitted for a month to precisely the same treatment. After they had become well established, they were separated into two lots of two each by a heavy tin plate of the full size of the box. The plants of one lot were now watered every few days with about half a pint each of a solu-

tion of one part of permanganate of potash in two thousand parts of water. Those of the other lot received none of the permanganate, but an equal quantity of water, and were, in other respects, under identical conditions. In three weeks a difference between the two lots was evident, and in a month it had become very conspicuous. The foliage of the treated plants was deeper green and much more abundant than that of the others. Ultimately the plants which received no permanganate died completely, their leaves turning brown over their entire surfaces, but showing no trace of the spot fungus. The plants which received the permanganate remained vigorous and healthy until taken out in the spring.

In view of this experience, Mr. Philbrick was advised to try the same treatment on a larger scale. This he did, and reported, after an experiment extending through a large part of February and March, 1892, that he could see absolutely no difference between treated and untreated plants. There is no reason for doubting and every reason for believing that this experiment was properly carried out, but its results are puzzling, in view of our experience with a few plants at Amherst. In the latter case the plants were in excellent soil, and the result cannot be attributed wholly to any possible fertilizing effect of the potash salt. It should be said, too, that the plants which died had still an apparent abundance of healthy roots, and their death did not appear to be due to the few Nematodes which were present. This view is sustained by the fact that plants died with the same symptoms in the bench, which showed no trace of Nematodes or of any disease of the roots. It is, however, true that the Nematodes in the roots of the treated plants disappeared, presumably as a result of the treatment, which has been used with success against root-attacking Nematodes.

In view of all the above facts, it seems most logical to conclude that, in the case of Mr. Philbrick's violets and in the death of plants at Amherst, root Nematodes have little or no share. We are left, then, to consider the only other foreign organism observed in connection with the trouble, the leaf-spot fungus. This, it may be said, has been believed by Mr. Philbrick from the first to be the efficient cause of the disease. In April, 1892, a lot of plants, both healthy

and badly attacked by the leaf-fungus, both those which had and those which had not been treated with permangate, were received from Mr. Philbrick. These were divided, as is the custom with violet growers, so as to leave a good portion of root to each, and set in good soil on one of the station plats. As they made new leaves no signs of the fungus were seen, and it was determined not to spray them at all unless the appearance of the fungus should demand it. Unfortunately for our study of the disease, the fungus did not appear during the summer, except on a very few leaves, and no test of the efficacy of spraying as a preventive of its spread was possible. Mr. Philbrick's experience was different. He sprayed a part of his plants with the ammoniacal carbonate of copper until about the middle of August, when a few days of warm, damp weather occurred, and the disease spread rapidly and fatally. As he could see no difference in the degree to which sprayed and unsprayed plants suffered, he gave up the treatment in disgust, and lost nearly all his plants. If it be true that the leaf-spot fungus is the cause of this very destructive disease, from which many violet growers near Boston suffer, — and all the facts now at hand point to this as the correct conclusion, — there is no apparent reason why thorough and persistent spraying with one of the copper preparations should not prove very efficient in holding it in check. And Mr. E. O. Orpet of South Lancaster informs me that he has had excellent success with this treatment. The failure above quoted was probably due to some error in carrying out the treatment. So far as I have been able to learn the details, the intervals between the applications were apparently so long as to leave the plants unprotected for a time in each interval. One of these periods of exposure coming in weather favorable to the spread of the fungus would be quite sufficient to account for the result; for, as has been so often said, a plant once infected is lost. The secret of immunity lies in complete protection of the plants against infection. A word more may not be out of place here. It is a common practice of growers of violets to keep them in activity during the entire year, forcing the vegetative growth during the summer and fall, and forcing the blossoms

during winter and spring. That this practice is exceedingly weakening to the plants, and renders them more susceptible to the attacks of disease-producing organisms, cannot be doubted. The more rational practice of some growers, of giving the plants a rest in the cold frame during a part of the year, cannot fail to produce more sturdy plants; and it may be doubted if it is not in the long run more profitable, when all factors are taken into account.

III. The Black Knot of the Plum. — *Plowrightia morbosa* (Sz.) Sacc. (Plate V.)

Work on other diseases has crowded out much which has been planned in continuation of that already reported * on this important trouble, but a few words may be added, especially in regard to the practical treatment of the disease. During the past year cultures with the ascospores and pycnospores of the fungus have been carefully repeated, with results in every case identical with those reported in our previous account. On bread saturated with an infusion of prunes, pycnospores, taken from pycnidia developed from ascospores on prune gelatine, produce a very luxuriant mycelium. This mycelium, at first white, soon assumes a salmon-red tint, and later becomes black. The first pycnidia on such a culture were ripe in five days from the sowing of the spores; but others continued to form until the entire surface of the substratum was covered by a compact pycnidial crust. This pycnidial form seems to be very rarely developed under natural conditions, but there can be no doubt that it belongs to the life cycle of the "black-knot" fungus. It seems very probable that some relation exists between its suppression and the facts next to be detailed, but this is not the place for the discussion of such probabilities. Careful experiments have been made as to the power of the pycnospores to infect the living tissues of the host-plant. It is clear that one or more of the spore forms of the fungus must possess such power, and it was hoped that experiments with each of the known forms might before now have been made. But this has not been possible. In case of the pycnospores

* Eighth Report Massachusetts Experiment Station, pp. 200–210, and Pl. I.

it has been found that they are quite incapable of attacking any of the living tissues of the host. They have been sown on sound and on injured leaves, and on stems of various ages, on those of the season and those of one, two and more years old. Whether sown on the intact surface of the stem, or allowed free access to the freshly exposed living tissues of the inner bark (Phloëm), the results have been the same. No development of knots has followed any of the sowings, nor has any trace of mycelial threads been found in the tissues exposed to them. It seems pretty certain, then, that they play no important part in the spread of the fungus.

Prevention. — Since we do not yet know the details of the infection of the host-plant by this fungus, we are not in a position to use fungicides intelligently. It is doubtless true that spraying at intervals during the whole period of the ripening and escape of both winter and summer spores, namely, from January to June, will largely prevent the attacks of this disease. But it is hardly less to be doubted that a complete filling of this important blank in the life history of the fungus will enable us to reduce the period of spraying to a relatively short one. On the other hand, I am convinced that the disease can be largely controlled without spraying, if fruit growers will learn to recognize its earliest appearance. The great difficulty at present lies in the fact that a few small knots, even when fully grown, often escape notice, and so serve as sources of infection; and indeed, the average man does not realize that his trees need attention and that the fungus is getting the better of them until they are so covered with knots as to be practically worthless. While, as for the early stages of the knot, before either of the spore forms have developed, no one thinks of looking for them and removing them when removal is of some avail. It is very rarely that a tree is badly attacked the first season. Commonly the beginning is the appearance of one or two small knots, of very little consequence alone, but sufficient to infect the whole tree in two or three years, if left. After a very little experience any one can recognize the forming knot even before it bursts the bark, and before it has done serious mischief. No one would mistake the large knot on the middle branch in Pl. V.; but it has

matured two crops of spores and done its work, and to remove it is a waste of time and labor. But just beneath it on the branch, and on each of the side branches, is a smaller and less conspicuous swelling, whose bark is just bursting. These swellings are knots a year younger than the large one, and have ripened no spores. The thorough removal of these is preventive work of the best kind. I firmly believe that a man who will start with healthy trees and will carefully examine them for these young knots about the last of April in every year (for the climate of Massachusetts), thoroughly removing and burning all that are found, need have very little fear of black knot. Where a small branch is attacked, one need only cut it off some distance below the knot. Where, as will rarely happen if trees are carefully looked after annually, a large branch whose removal would seriously injure the tree is involved, the knot may be carefully dug out until healthy bark is reached in all directions. The exposed tissues may then be painted over with a heavy coat of red oxide of iron in linseed oil. This coating will serve as a protection, and will also, by its color, enable one to readily find the treated spots and to watch them for any further development of the fungus. The application of kerosene to the knots, while doubtless fatal to the fungus, is likely to be equally so to the tissues of the tree, and is not to be recommended as a general practice.

For the greatest success in dealing with the black knot, it is, of course, a prime necessity that sources of infection shall be reduced to a minimum. Neighboring plum or cherry trees or wild plants of the various native species of plums and cherries may serve as propagators of the fungus, and make one's labors much greater and his chances of success much smaller. The great desideratum in this regard is an intelligent and active public sentiment, which shall compel the destruction of all such plague-breeders. A few of our States have accepted the suggestion that the matter be made the subject of legislation, and have enacted laws to compel the destruction of trees infected by the black knot. One may, however, well doubt the utility of such legislation. It is interesting, as showing the beginning of toleration for subjects which, not long ago, would

have been thought unworthy of serious attention. But the enforcement of thorough-going legislation is not possible without the active support of public sentiment; and a public sentiment sufficiently aroused to execute the law would accomplish the desired result without legislation.

IV. Grain Rusts (*Puccinia* sp.).

Last spring an attempt was made by this department to enlist the practical farmers and gardeners of the State in aid of a plan for the organization of a system for the report of the prevalence of plant diseases in any locality. It has been manifestly impossible for the writer to travel about the State, and, at the same time, to carry on studies in Amherst, and the value of organized co-operation has been long realized. Therefore a special circular to those concerned was widely distributed, and it was hoped, in view of the interest in the work of the department which had been shown in some quarters, the response might be encouraging. It proved, however, disappointing in a marked degree. While five or six of the most intelligent cultivators in the State responded promptly, they remained the only persons who did so. This test must prove interesting to pathologists at least, as showing what support they may expect at present from people reputed to possess a high average degree of intelligence. It is clear that agriculturists and horticulturists in general are not yet willing to go out of their way even to aid work carried on in their interest and for their benefit. And it is the experience of the writer that only the most wide-awake of them are willing to avail themselves of the results of such work, if it involves the least deviation from the old ruts. But it is noticeable that those who are alive to the results of modern investigations are not those who complain that "farming doesn't pay."

It had been hoped to obtain from correspondents pretty full information concerning the rusting of grains during the season, as this constituted the special subject of inquiry for the year of the International Phytopathological Commission. In the absence of information from these sources, the writer has been compelled to rely upon others, especially the various official crop reports. It seems that, so far as New

England is concerned, the season has been far less favorable to the development of the rust fungi than in previous years. The losses appear to have been very light from this cause, and it has not been possible to obtain data of value concerning them. The only crop distinctly mentioned as suffering at all has been oats, and it is by no means certain that the cause of its affection was one of the species of *Puccinia* to which the true rusting of grain is due. The season of 1892 must, therefore, be set down as one of unfavorable conditions and negative results in New England.

V. Notes on Various Diseases.

1. The Powdery Mildew of the Strawberry (*Sphærotheca Castagnei* Lév. ?) (Pl. III.) was brought to my attention on the experimental plats of the Agricultural College, early last summer. The affection shows itself in a peculiar curling or inrolling of the leaves, which causes them to take a somewhat cup-like form. If the lower surfaces of the curled leaves be carefully examined, they will be seen to be frosted by minute white threads scattered rather sparingly over them. They are not grouped in more or less circumscribed spots, like those of the similar mildew of the cucumber, previously described. But microscopic examination shows that their structure is essentially like those of the "*Oidium*" form of the latter. Erect threads arising from the mycelium (fig. 20) cut off the summer spores from their ends in basipetal succession, and these fall off as they mature (fig. 21). The form and size of these spores (fig. 22) confirm the impression produced by the habit of growth that we have here to do with a species quite distinct from that which attacks the cucumber. Although I have not observed the perfect spore form, it is probable that the fungus with which we have here to do is *Sphærotheca Castagnei*.

This fungus does not appear to be very destructive to the strawberry, or to have attracted much attention. It has been briefly described by Arthur,* who observed it in New York. He found it attacking the fruit as well as the foliage,

* Fifth Report New York Experiment Station, p. 291, 1887.

and indeed doing its chief harm in rendering the former insipid and worthless. I have not seen it on the fruits, but it may be likely to be found upon them, and in this aspect the fungus may assume, under favoring conditions, considerable economic importance. Suggestions as to treatment may be found on subsequent pages.

2. THE POWDERY MILDEW OF THE GOOSEBERRY (*Sphærotheca mors-uvæ* (Sz.) B. & C.) (Pl. III.) was received, last summer, from W. C. Strong, Esq., of Waban, on the leaves, twigs and berries of the "Triomphe" gooseberry, a variety which has been claimed to be mildew-proof. In the present case the utter groundlessness of such a claim was strikingly shown, and afforded further evidence that we are safe only in speaking of varieties as more or less liable to the attacks of fungous diseases. It is not probable that any of our horticultural varieties are in any absolute sense disease-proof, and it may fairly be doubted if we shall ever originate such, without sacrifice of more essential features, even with constantly increasing understanding of the requisite qualities.

This fungus is very closely related to that last described, and differs from it only in very unimportant particulars. The mycelium forms a dense felt over the infected parts of the host-plant, and in the early part of the season is nearly colorless, and produces the "*Oidium*" form in abundance. Later, the mycelium becomes quite dark-colored, and gives rise to the perfect spore form (figs. 23, 24). As above indicated, all the younger, succulent parts of the plant may be involved, and thus not only is the season's fruit destroyed, but the normal production of new wood and preparation for another season is prevented. This gives to the fungus great economic importance, especially since it is widely distributed. It has been frequently mentioned by writers on plant diseases, and the accounts by Arthur * and Halsted † may be consulted for further information. Notes on the treatment of this class of diseases are given later.

* Sixth Report New York Experiment Station, p. 349, 1888.

† Mycological Report, United States Department Agriculture, 1887, p. 373, with plate.

3. The Cluster Cup of the Gooseberry (*Æcidium Grossulariæ* Schum.) occurred also on some of the leaves sent by W. C. Strong, Esq., as mentioned in the previous note. Gooseberry leaves and berries very badly attacked were also received, about the same time, through the "New England Homestead," from Mr. C. C. Stickney of Ballardvale. From the facts which came to my notice during the season, it would appear that this fungus has been more than usually abundant this year. It may commonly be found in early summer on gooseberry bushes, and occurs also on some of our wild and cultivated species of currants (*Ribes*) ; but it is rarely very destructive. It may, however, as was seen this year, assume serious proportions, practically destroying a large part of foliage and fruit. It seems not to have attracted much attention as a cause of loss, but has lately been said by Pammel* to be quite destructive in Iowa. The form we are considering is the "cluster-cup" stage of one of the *rust* fungi. The bright yellow cups occur in groups on somewhat swollen and discolored portions of the leaves or berries, and contain the chains of spores by which the further development of the species is accomplished. It is probable that, as in other rusts, this "cluster cup" is followed by *red-rust* and *black-rust* forms. But, as these are not known to be developed on the same host-plant, they are probably produced on a second one. This would place the present fungus among the *heterœcious* rusts. So long, however, as we do not know its life history, we cannot avail ourselves of all the means of combating it.

When the cluster cup begins to appear, in spring or early summer, the harm for that season is done, and cannot be avoided. Yet, if the discolored spots be watched for and the affected parts picked and burned before the cups have burst open and discharged their spore, one may hope to escape attack in a considerable measure the following year; and the annual repetition of this practice should result in comparative immunity from the fungus. This recommendation is based on the justifiable assumption that the cluster-cup form requires for its reappearance the development of

* Journal of Mycology, VII., p. 101, 1892.

the other spore forms of the fungus, and that this last development cannot occur if the dissemination of cluster-cup spores be prevented. That this is true has not yet been proven, but, in the light of what we know of other rust fungi, it may fairly be assumed until more positive information is available.

4. A Hazel Fungus (*Cryptosporella anomala* (Pk.) Sacc.) (Pl. IV.) was left at the station in April by Mr. Henry Graves of Palmer. He reported it as killing the canes of the European hazel (*Corylus avellana*) in a plantation owned by him, and as attacking an annually increasing portion of the plantation. The fungus proved to be that known by the above name, which was first described by Peck,* who observed it on the same host at Albany, N. Y., as *Diatrype anomala*. It appears in the form of protuberances with elliptical bases (fig. 30) that burst the bark and arise rather thickly from the affected portion of the branch (*a*, fig. 30), which is sunk below the surface of the healthy part. A transverse section of the branch passing through one of these protuberances shows well the structure of the fungus and its relation to the host-plant. The interior of the protuberance, which is the fructificative part of the fungus, is seen to contain numerous black, flask-like structures, whose tips reach the surface of the protuberance (fig. 31). Within the cavities of these flasks are formed the very numerous spindle-shaped spore sacs (fig. 32), each containing, when ripe, eight colorless, elliptical spores. It is very noticeable that, in the part of the branch occupied by the fungus, the inner bark, elsewhere a distinct band of tissue, is shrunken to a narrow black line between the wood and outer bark (*a*, fig. 31). This reduction in the thickness of the inner bark explains at once why the surface of the affected parts is sunken below the rest of the surface, and shows that the chief seat of the vegetative activity of the fungus is in the rich growing and conducting tissues of this part of the branch. The destruction of these tissues must, in any event, have serious consequences for the plant; and, if the entire circumference of a cane becomes involved,

* Twenty-eighth Report New York State Museum, p. 72, 1879.

the result is that it is girdled, and the whole of it beyond the point of girdling dies. The attacks of this fungus on its host-plant are essentially similar in their results to those of the black knot on the plum, though the immediate effect on the inner bark is here one of atrophy, while in the latter case it is one of hypertrophy. The present fungus is also nearly related to the black-knot fungus, but its life history is not yet at all known. What other spore forms constitute stages in its life cycle we have yet to learn. Therefore, it is impossible to give any more definite suggestions for avoiding it than to recommend that infected branches be cut away well below the point of infection and burned as soon as they are seen to be infected. This precaution, if taken in season, will prevent the dissemination of the spores described above, and should thus prevent the development of other spore forms dependent on them, and the infection of new branches.

VII. Treatment for Powdery Mildews.

In pursuance of the plan indicated in our last report,* we conclude the present one with recommendations for the avoidance of loss from the attacks of some chosen groups of fungi. The group selected in the present case is that embracing those fungi which are known as the powdery mildews. These parasites attack a considerable number of cultivated plants, and, as has been seen, sometimes cause extensive losses. They are among the commonest fungi of the greenhouse, but are equally common in summer, in the open air. Among the plants most often attacked by some one of the powdery mildews in the greenhouse are the cucumber, grape, rose, verbena and other florist's plants. Out of doors, the pea, gooseberry, strawberry, and young plants of the apple and cherry often suffer from them

The appearances produced on their host-plants by three species of powdery mildews have already been described in this report. In general, it may be said that it is in the summer spore stage that these fungi are most harmful as disease producers. In this stage they may form dense white "floury" patches on the host, usually on its leaves, or the

* Ninth Report Massachusetts Experiment Station, pp. 243, 244.

spore threads may be quite sparingly developed, so that only a faint frosting is to be seen. In attacks of much severity there is commonly a discoloration, followed finally by the drying up of the tissues affected. As has been seen above in our discussion of some diseases due to these fungi, they are surface parasites. The whole fungus grows on the exterior of its host, except the small absorbing organs, which penetrate only the superficial cells. And this fact makes it much easier to deal with these fungi than with those which are truly internal parasites, since practically the whole of the fungus is exposed to the contact and action of any fungicides applied to the surface of the host-plant.

It should not be necessary to insist upon the prime importance of healthy conditions, so repeatedly emphasized in these reports, and it may be assumed that it is not necessary. Supposing, then, that reasonable precautions against the appearance of fungous disease have been taken, and that one of the powdery mildews appears, what can be done? The question may be discussed under two heads, namely, What can be done for plants in the greenhouse? And for those in the open air? If the disease appears in a greenhouse, either of the applications to be recommended for out-of-door plants may be used with equal success. But, if the house can be tightly closed, we have at hand a simpler, and, from the testimony of practical men, an even more satisfactory, means of treatment. This consists in filling the air of the tightly closed house with the vapor of sulphur, which is fatal to these surface parasites, without injuring their host-plants, if the exposure be not continued much beyond half an hour at a time. After this treatment ventilators should be opened, and the house given a thorough airing. The treatment may be repeated whenever the reappearance of the fungus shows it to be necessary. The sulphur vapor is easily produced by heating the flowers of sulphur to a temperature somewhat above its melting point, and keeping it at that point as long as desired. A porcelain-lined iron vessel for the sulphur and a small oil stove for heating constitute the entire outfit needed for a small house. For a large one as many such outfits may be used as are required to yield vapor enough to saturate the atmosphere of the room. Great care

must be taken that the sulphur does not become so hot as to take fire, as a brief exposure to the fumes of burning sulphur will kill cultivated plants, as well as fungi. But a little experience will soon enable one to set the flame of the oil stoves at such a height that it can be safely left to do its work.

If the plants to be protected are out of doors, it is evident that we cannot use sulphur vapor. Here we must rely on a direct application to their surfaces. Dry flowers of sulphur scattered upon the plants or blown upon them with a bellows is often of considerable service. But a solution sprayed upon the plants, by means of some of the spraying machines recommended in previous publications of this department,* is much more efficient. Formulæ for several solutions may be found in the publications just referred to,* but that most generally applicable and most satisfactory in its application and in its results is the ammoniacal carbonate of copper. The formula for this fungicide may be, for convenience, repeated here: mix one ounce carbonate of copper with five ounces carbonate of ammonia, and dissolve in one quart hot water. When dissolved, add sixteen gallons water. This may be used to thoroughly spray the plants as often as the presence of the fungus in harmful quantities shows it to be necessary. For spraying a few plants only, such as a few rose or gooseberry bushes, hand sprayers may be purchased at a price much below that of the cheapest knapsack sprayer. But care should be taken that the apparatus used throws a very fine, mist-like spray. Full directions and suggestions as to spraying in general may be found in the previous publications of this department on the subject.

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* See Bulletin No. 39, Massachusetts Experiment Station, and Ninth Report Massachusetts Experiment Station, pp. 239, 240.

EXPLANATION OF PLATES.

[*All figures are magnified 540 diameters, except where otherwise specified.*]

PLATE I.

SCLEROTIUM DISEASE OF CUCUMBER (*Sclerotinia Libertiana* F'k'l.).

Stems and young fruit attacked by the disease, showing mycelium of the fungus, chiefly at the nodes of the stems, and some external sclerotia. *a*, an early stage, the stem still green; *b*, later, the internode shrinking, and a sclerotium near the upper node; c, a late stage, the parenchyma largely destroyed, and the stem yellow; *d* and *e*, at about the same stage as *b*; *fr*., a young fruit, showing mycelium and sclerotia. Natural size. From a photograph of fresh specimens.

PLATE II.

SCLEROTIUM DISEASE OF CUCUMBER (*Sclerotinia Libertiana* F'k'l.).

Fig. 1. An elongated sclerotium from the interior of a stem. Natural size.
Fig. 2. An irregular sclerotium from the exterior of the host-plant. Natural size.
Fig. 3. A sclerotium somewhat advanced in "germination," with two stalks. Natural size.
Fig. 4. Two views (*a* and *b*) of the same sclerotium, with fruit stalks, *b* four days older than *a*. Natural size.
Fig. 5. Two views of another "germinating" sclerotium, taken four days apart. Natural size.
Fig. 6. A section from the interior of a mature sclerotium. × 350.
Fig. 7. One of the fruit stalks shown in fig. 3, in vertical section. × 19.
Fig. 8. Three asci and two paraphyses from a well-developed cup. One ascus with forming spores, one with fully formed spores, and one after the escape of its spores, *sp*.
Fig. 9. Three ascospores germinated in water, after one day.
Fig. 10. Three ascospores after one day in prune infusion.
Fig. 11. A well-developed young attachment organ. × 350.
Fig. 12. A part of an old attachment organ. × 350.
Fig. 13. Spore threads and conidia (*sp*.) of *Botrytis* form, showing, *y*, young threads before the formation of spores, and, *o*, old threads after the falling away of the spores. × 200. *a*, conidia more magnified. × 540.

PLATE III.

POWDERY MILDEWS.

Figs. 14-19. Of cucumber (*Erysiphe Cichoracearum* D. C.).
Fig. 14. Epidermis of upper surface of leaf, with mycelium, *m*, of fungus giving rise to haustoria, *h*, and spore threads, *sp*.
Fig. 15. Three spore threads, with spores in various stages of development.
Fig. 16. Two ripe summer spores not yet fallen apart.
Fig. 17. Two ripe summer spores of a similar fungus from Ithaca, N. Y.
Fig. 18. A group of six spore sacs (*asci*), with spores, from the same perithecium.
Fig. 19. A ripe ascospore.
Figs. 20-22. Of strawberry (*Sphærotheca Castagnei* Lév. ?).
Fig. 20. A bit of mycelium, with a spore thread. × 200.
Fig. 21. The upper part of a spore thread, with developing spores.
Fig. 22. Two ripe summer spores.
Figs. 23-24. Of gooseberry (*Sphærotheca Mors-uvæ* (Sz.) B. & C.).
Fig. 23. The single spore sac produced in a perithecium, with spores.
Fig. 24. Four ripe ascospores.

PLATE IV.

CUCUMBER DISEASES.— *Hazel Fungus.*

Figs. 25-26. Leaf blight (*Cladosporium cucumerinum* Ell. & Arth.).

Fig 25. Epidermis of lower surface of leaf, with stomata, *st.*, showing mycelium, *m*, and hyphal knots, giving rise to spore threads. *sp.*, detached spores of the fungus.

Fig. 26. Mycelium, *m*, and hyphal knot, *a*, giving rise to spore threads, the latter with highly developed spore chains.

Figs. 27-29. Leaf glaze (*Acremonium* sp.).

Fig. 27. Mycelium giving rise to numerous spore threads.

Fig. 28. Ripe spores, fallen from the threads.

Fig. 29. Spores germinating in water.

Figs. 30-33. Hazel fungus (*Cryptosporella anomala* (Pt.) Sacc.).

Fig. 30. A piece of a branch of hazel, showing the depressed region occupied by the fungus, *a*, and fourteen of its compound spore fruits. Natural size.

Fig. 31. A vertical section, showing five spore cavities, through a spore fruit lying at the margin of the infested area, showing the wood of the branch, *w*, the inner bark, *a*, in normal condition at the right and destroyed by the fungus at the left, and the outer bark, *o*. × 3.

Fig. 32. An ascus with its eight spores. × 940.

Fig. 33. Three ripe spores. × 940.

PLATE V.

THE BLACK KNOT OF PLUM AND CHERRY (*Plowrightia morbosa* (Sz.) Sacc.).

Three young branches from the wild black cherry (*Prunus serotina*), taken about May 1, showing two stages of the knot. In the large knot, *o*, the development and escape of the winter spores has just been completed, and its activity is past. The three small knots, *a*, just bursting the bark, are a year younger than the large one, and are about to begin the production of their summer spores. Natural size. From a photograph.

PART III.

SPECIAL WORK IN THE CHEMICAL LABORATORY.

I. Communication on Commercial Fertilizers: —
   1. General Introduction.
   2. State Laws for the Regulation of Trade in Commercial Fertilizers.
   3. List of Licensed Manufacturers and Dealers from May 1, 1892, to May 1, 1893 (51).
   4. Analyses of Licensed Fertilizers (185).
   5. Analyses of Commercial Fertilizers and Manurial Substances sent on for Examination (114).
   6. Miscellaneous Analyses (9).

II. Analyses of Milk sent on for Examination (113).

III. Analyses of Water sent on for Examination (109).

IV. Compilation of Analyses made at Amherst, Mass., of Agricultural Chemicals and Refuse Materials used for Fertilizing Purposes.

V. Compilation of Analyses made at Amherst, Mass., of Fodder Articles, Fruits, Sugar-producing Plants, Dairy Products, etc.

I.

COMMUNICATION ON COMMERCIAL FERTILIZERS.

1. General introduction.
2. State laws for the regulation of trade in commercial fertilizers.
3. List of licensed manufacturers and dealers from May 1, 1892, to May 1, 1893.
4. Analyses of licensed fertilizers.
5. Analyses of commercial fertilizers and manurial substances sent on for examination.
6. Miscellaneous analyses.

1. General Introduction.

The sale of commercial manurial substances, compound and simple, has been quite extensive in our State. Fifty-one manufacturers and dealers have applied and received a license for the sale of their various brands in our State. Thirty-three of them are residents of other States.

Two hundred and three samples of licensed articles have been collected in all parts of the State by a duly authorized agent of the station. One hundred and eighty-five of them have been carefully analyzed at the chemical laboratory of the station, with the following results: no sample contained all three essential constituents above the highest guarantee; sixteen samples contained two of the essential constituents above the highest guarantee; sixty-two samples contained one of the essential elements above the highest guarantee; thirty-eight samples contained all three essential elements at the lowest guarantee; sixty-four samples contained two elements at the lowest guarantee; fifty-two samples contained one element at the lowest guarantee; no sample contained all three essential elements below the stated lowest guarantee; fifteen contained two elements below the stated

lowest guarantee; fifty-seven contained one element below the lowest stated guarantee. The deficiency in one or two essential constituents was in the majority of instances compensated for by an excess in the others.

The variations in the market price of the various prominent fertilizer constituents have been, on the whole, during the past year within the usual limits. Phosphoric acid in all forms has been offered at a somewhat lower cost towards the close of the year, while that of nitrogen in its leading forms has somewhat advanced.

The duties assigned to the director of the station, to act as inspector of commercial fertilizers, render it necessary to *discriminate*, in official publications of the results of analyses of commercial fertilizers and of manurial substances in general made at the station, *between analyses of samples collected by a duly qualified delegate of the experiment station, in conformity with the rules prescribed by the new laws, and those analyses which are made of samples sent on for that purpose by outside parties.* In regard to the former alone can the director assume the responsibility of a carefully prepared sample, and of the identity of the article in question.

The official report of analyses of compound fertilizers and of all such materials as are to be used for manurial purposes, which are sold in this State under a certificate of compliance with the present laws for the regulation of the trade in these articles, has been restricted by our State laws to a statement of chemical composition and to such additional information as relates to the latter.

The practice of affixing to each analysis of this class of fertilizers an approximate commercial valuation per ton of their principal constituents has, therefore, been discontinued. This change, it is expected, will tend to direct the attention of the consumers of fertilizers more forcibly towards a *consideration of the particular composition of the different brands of fertilizers offered for their patronage, a circumstance not infrequently overlooked.*

The *approximate market value* of the different brands of fertilizers obtained by the current mode of valuation does

not express *their respective agricultural value*, i. e., their crop-producing value; for the higher or lower market price of different brands of fertilizers does not necessarily stand in a direct relation to their particular fitness, without any reference to the particular condition of the soil to be treated and the special wants of the crops to be raised by their assistance.

To select judiciously from among the various brands of fertilizers offered for patronage requires, in the main, two kinds of information; namely, we ought to feel confident that the particular brand of fertilizer in question actually contains the guaranteed quantities and qualities of essential articles of plant food at a reasonable cost, and that it contains them in such form and such proportions as will best meet existing circumstances and special wants. In some cases it may be mainly either phosphoric acid or nitrogen or potash; in others, two of them; and in others again, all three. A remunerative use of commercial fertilizers can only be secured by attending carefully to the above-stated considerations.

To assist farmers not yet familiar with the current mode of determining the commercial value of manurial substances offered for sale in our markets, some of the essential considerations, which serve as a basis for their commercial valuation, are once more stated within a few subsequent pages.

The hitherto customary valuation of manurial substances is based on the average trade value of the essential fertilizing elements specified by analysis. The money value of the higher grades of agricultural chemicals and of the higher-priced compound fertilizers depends, in the majority of cases, on the amount and the particular form of two or three essential articles of plant food, i. e., phosphoric acid, nitrogen and potash, which they contain. To ascertain by this mode of valuation the approximate market value of a fertilizer (i. e., the money worth of its essential fertilizing ingredients), we multiply the pounds per ton of nitrogen, etc., by the trade value per pound; the same course is adopted with reference to the various forms of phosphoric

acid and of potassium oxide. We thus get the values per ton of the several ingredients, and, adding them together, we obtain the total valuation per ton in case of cash payment at points of general distribution.

The market value of low-priced materials used for manurial purposes, as salt, wood ashes, various kinds of lime, barn-yard manure, factory refuse and waste materials of different description, quite frequently does not stand in a close relation to the market value of the amount of essential articles of plant food they contain. Their cost varies in different localities. Local facilities for cheap transportation, and more or less advantageous mechanical condition for a speedy action, exert, as a rule, a decided influence on their selling price.

The mechanical condition of any fertilizing material, simple or compound, deserves the most serious consideration of farmers, when articles of a similar chemical character are offered for their choice. The degree of pulverization controls, almost without exception, under similar conditions, the rate of solubility, and the more or less rapid diffusion of the different articles of plant food throughout the soil.

The state of moisture exerts a no less important influence on the pecuniary value in case of one and the same kind of substance. Two samples of fish fertilizers, although equally pure, may differ from fifty to one hundred per cent. in commercial value on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers, and refuse materials of various descriptions, have to be valued with reference to the market price of their principal constituents, taking into consideration at the same time their general fitness for speedy action.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals (1892).

	Cents per Pound.
Nitrogen in ammoniates,	17.5
Nitrogen in nitrates,	15.
Organic nitrogen in dry and fine ground fish, meat, blood,	16.
Organic nitrogen in cotton-seed meal and castor pomace,	15.
Organic nitrogen in fine-ground bone and tankage,	15.
Organic nitrogen in fine-ground medium bone and tankage,	12.
Organic nitrogen in medium bone and tankage,	9.5
Organic nitrogen in coarser bone and tankage,	7.5
Organic nitrogen in hair, horn shavings and coarse fish scraps,	7.
Phosphoric acid soluble in water,	7.5
Phosphoric acid soluble in ammonium citrate,	7.
Phosphoric acid in dry ground fish, fine bone and tankage,	7.
Phosphoric acid in fine medium bone and tankage,	5.5
Phosphoric acid in medium bone and tankage,	4.5
Phosphoric acid in coarse bone and tankage,	3.
Potash as high-grade sulphate, and in forms free from muriate or chlorides, ashes, etc.,	5.5
Potash as kainite,	4.5
Potash as muriate,	4.5

The organic nitrogen in *superphosphates, special manures and mixed fertilizers of a high grade* is usually valued at the highest figures laid down in the trade values of fertilizing ingredients in raw materials, namely, fifteen and a half cents per pound; it being assumed that the organic nitrogen is derived from the best sources, viz., animal matter, as meat, blood, bones, or other equally good forms, and not from leather, shoddy, hair, or any low-priced, inferior form of vegetable matter, unless the contrary is ascertained. The insoluble phosphoric acid is valued in this connection at two cents.

The above trade values are the figures at which, in the six months preceding March, 1891, the respective ingredients could be bought at *retail for cash in our large markets, in the raw materials*, which are the regular source of supply.

They also correspond to the average wholesale prices for the six months ending March 1, plus about twenty per cent.

in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to agree fairly with the retail price at the large markets of standard raw materials, such as : —

Sulphate of ammonia,	Dry ground fish,
Nitrate of soda,	Azotin,
Muriate of potash,	Ammonite,
Sulphate of potash,	Castor pomace,
Dried blood,	Bone and tankage,
Dried ground meat,	Plain superphosphates.

A large percentage of commercial materials consists of refuse matter from various industries. The composition of these substances depends on the mode of manufacture carried on. The rapid progress in our manufacturing industries is liable to affect at any time, more or less seriously, the composition of the refuse. To assist the farming community in a clear and intelligent appreciation of the various substances sold for manurial purposes, a frequent examination into the temporary characters of agricultural chemicals and refuse materials offered in our markets for manurial purposes is constantly carried on at the laboratory of the station.

Consumers of commercial manurial substances do well to buy, whenever practicable, on guarantee of composition with reference to their essential constituents, and to see to it that the bill of sale recognizes that point of the bargain. Any mistake or misunderstanding in the transaction may be readily adjusted, in that case, between the contending parties. The responsibility of the dealer ends with furnishing an article corresponding in its composition with the lowest stated quantity of each specified essential constituent.

Our present laws for the regulation of the trade in commercial fertilizers include not only the various brands of compound fertilizers, but also all materials, single or compound, without reference to source, used for manurial purposes when offered for sale in our market at ten dollars or more per ton. Copies of our present laws for the regulation of the trade in commercial fertilizers may be had by all interested, on application, at the Massachusetts State Agricultural Experiment Station, Amherst, Mass.

2. The Provisions of the Act are as follows:

[Chapter 296.]

An Act to regulate the sale of commercial fertilizers.

Be it enacted, etc., as follows:

Section 1. Every lot or parcel of commercial fertilizer or material used for manurial purposes sold, offered or exposed for sale within this Commonwealth, the retail price of which is ten dollars or more per ton, shall be accompanied by a plainly printed statement clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand or trade mark under which the fertilizer is sold, the name and address of the manufacturer or importer, the place of manufacture, and a chemical analysis stating the percentage of nitrogen or its equivalent in ammonia, of potash soluble in distilled water, and of phosphoric acid in available form soluble in distilled water and reverted, as well as the total phosphoric acid. In the case of those fertilizers which consist of other and cheaper materials, said label shall give a correct general statement of the composition and ingredients of the fertilizer it accompanies.

Sect. 2. Before any commercial fertilizer, the retail price of which is ten dollars or more per ton, is sold, offered or exposed for sale, the importer, manufacturer or party who causes it to be sold or offered for sale within the state of Massachusetts, shall file with the director of the Massachusetts agricultural experiment station, a certified copy of the statement named in section one of this act, and shall also deposit with said director at his request a sealed glass jar or bottle, containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.

Sect. 3. The manufacturer, importer, agent or seller of any brand of commercial fertilizer or material used for manurial purposes, the retail price of which is ten dollars or more per ton, shall pay for each brand, on or before the first day of May annually, to the director of the Massachusetts agricultural experiment station, an analysis fee of five dollars for each of the three following fertilizing ingredients: namely, nitrogen, phosphorus and potassium, contained or claimed to exist in said brand or fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any person acting as agent or seller for such manufacturer or importer, such agent or seller shall not be required to pay the fee named in this section; and on receipt of

said analysis fees and statement specified in section two, the director of said station shall issue certificates of compliance with this act.

Sect. 4. No person shall sell, offer or expose for sale in the state of Massachusetts, any pulverized leather, raw, steamed, roasted, or in any form as a fertilizer, or as an ingredient of any fertilizer or manure, without an explicit printed certificate of the fact, said certificate to be conspicuously affixed to every package of such fertilizer or manure and to accompany or go with every parcel or lot of the same.

Sect. 5. Any person selling, offering or exposing for sale, any commercial fertilizer without the statement required by the first section of this act, or with a label stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, or respecting the sale of which all the provisions of the foregoing section have not been fully complied with, shall forfeit fifty dollars for the first offence, and one hundred dollars for each subsequent offence.

Sect. 6. This act shall not affect parties manufacturing, importing or purchasing fertilizers for their own use, and not to sell in this state.

Sect. 7. The director of the Massachusetts agricultural experiment station shall pay the analysis fees, as soon as received by him, into the treasury of the station, and shall cause one analysis or more of each fertilizer or material used for manurial purposes to be made annually, and publish the results monthly, with such additional information as circumstances advise: *provided*, such information relates only to the composition of the fertilizer or fertilizing material inspected. Said director is hereby authorized in person or by deputy to take a sample, not exceeding two pounds in weight, for analysis, from any lot or package of fertilizer or any material used for manurial purposes which may be in the possession of any manufacturer, importer, agent or dealer; but said sample shall be drawn in the presence of said party or parties in interest or their representative, and taken from a parcel or a number of packages which shall be not less than ten per cent. of the whole lot inspected, and shall be thoroughly mixed and then divided into two equal samples and placed in glass vessels and carefully sealed and a label placed on each, stating the name or brand of the fertilizer or material sampled, the name of the party from whose stock the sample was drawn and the time and place of drawing, and said label shall also be signed by the director or his deputy and by the party or parties in interest or their representatives present at the drawing and sealing of said sample; one of

said duplicate samples shall be retained by the director and the other by the party whose stock was sampled. All parties violating this act shall be prosecuted by the director of said station; but it shall be the duty of said director, upon ascertaining any violation of this act, to forthwith notify the manufacturer or importer in writing, and give him not less than thirty days thereafter in which to comply with the requirements of this act, but there shall be no prosecution in relation to the quality of the fertilizer or fertilizing material if the same shall be found substantially equivalent to the statement of analysis made by the manufacturer or importer.

SECT. 8. Sections eleven to sixteen inclusive of chapter sixty of the Public Statutes are hereby repealed.

SECT. 9. This act shall take effect on the first day of September in the year eighteen hundred and eighty-eight. [*Approved May 3, 1888.*]

Instructions to Manufacturers, Importers, Agents and Sellers of Commercial Fertilizers or Materials used for Manurial Purposes in Massachusetts.

1. An application for a certificate of compliance with the regulations of the trade in commercial fertilizers and materials used for manurial purposes in this State must be accompanied: —

First, with a distinct statement of the name of each brand offered for sale.

Second, with a statement of the amount of phosphoric acid, of nitrogen and of potassium oxide guaranteed in each distinct brand.

Third, with the fee charged by the State for a certificate, which is five dollars for each of the following articles, nitrogen, phosphoric acid and potassium oxide, guaranteed in any distinct brand.

2. The obligation to secure a certificate applies not only to compound fertilizers but to all substances, single or compound, used for manurial purposes, and offered for sale at ten dollars or more per ton of two thousand pounds.

3. The certificate must be secured annually before the first of May.

4. Manufacturers, importers and dealers in commercial fertilizers can appoint in this State as many agents as they

desire, after having secured at this office the certificate of compliance with our laws.

5. Agents of manufacturers, importers and dealers in commercial fertilizers are held personally responsible for their transactions until they can prove that the articles they offer for sale are duly recorded in this office.

6. Manufacturers and importers are requested to furnish a list of their agents.

7. All applications for certificates should be addressed to the Director of the Massachusetts State Agricultural Experiment Station.

Arrangements are made, as in previous years, to attend to the examination of objects of general interest to the farming community, to the full extent of existing resources. Requests for analyses of substances — as fodder articles, fertilizers, etc. — coming through officers of agricultural societies and farmers' clubs within the State will receive hereafter, as in the past, first attention, and in the order that the applications arrive at the office of the station. The results will be returned without a charge for the services rendered. Application of private parties for analyses of substances, free of charge, will receive a careful consideration whenever the results promise to be of a more general interest. For obvious reasons, no work can be carried on at the station of which the results are not at the disposal of the managers for publication, if deemed advisable in the interest of the citizens of the State.

All parcels and communications sent to "The Massachusetts State Experiment Station" must have express and postal charges prepaid, to receive attention.

3. List of Manufacturers and Dealers who have secured Certificates for the Sale of Commercial Fertilizers in this State during the Past Year (May 1, 1892, to May 1, 1893), and the Brands licensed by Each.

Adams & Thomas, Springfield, Mass. : —
Adams's Market Bone Fertilizer.

Allen Fertilizer Company, Boston, Mass. : —
Allen Fertilizer.

Ames Fertilizer Company, Peabody, Mass. : —
Plymouth Roek Brand.

H. J. Barker & Bro., New York, N. Y. : —
" A. A." Ammoniated Superphosphate.
Standard U N X L D Fertilizer.
Special Corn Manure.
Special Grass Manure.
Special Potato Manure.
Speeial Tobaeco Manure.
Fine Raw Ground Bone.

C. A. Bartlett, Worcester, Mass. : —
Animal Fertilizer.
Fine-ground Bone.

Bowker Fertilizer Company, Boston, Mass. : —
Stockbridge Manures.
Bowker's Ammoniated Bone Fertilizer.
Bowker's Sure Crop Bone Phosphate.
Bowker's Hill and Drill Phosphate.
Bowker's Farm and Garden Phosphate.
Bowker's Lawn and Garden Dressing.
Bowker's Fresh Ground Bone.
Bowker's Dry Ground Fish.
Bowker's Fish and Potash.
Gloueester Fish and Potash.
Breck's Lawn and Garden Dressing.
Dried Blood.
Dissolved Bone-blaek.
Nitrate of Soda.
Muriate of Potash.
Sulphate of Potash.

Bradley Fertilizer Company, Boston, Mass.: —
X. L. Superphosphate of Lime.
B. D. Sea-fowl Guano.
Original Coe's Superphosphate.
Farmer's New-method Fertilizer.
English Lawn Dressing.
High-grade Tobacco Manure.
Bradley's Complete Manures: —
For Corn and Grain.
For Potatoes and Vegetables.
For Top-dressing Grass and Grain.
Bradley's Potato Manure.
Pure Fine-ground Bone.
Fish and Potash.
Dissolved Bone-black.
Nitrate of Soda.
Sulphate of Ammonia.
Muriate of Potash.
Sulphate of Potash.

W. J. Brightman & Co., Tiverton, R. I.: —
Dry Ground Fish.
Fish and Potash.
Superphosphate.

Bryant & Brett, New Bedford, Mass.: —
Ground Bone.

Burgess & Roy, South Attleborough, Mass.: —
Animal Fertilizer.

Joseph Church & Co., Tiverton, R. I.: —
Pure Dry Ground Fish (A Brand).
Special Fertilizer (B Brand).
Standard Fertilizer (C Brand).
Fish and Potash (D Brand).

Clark Cove Fertilizer Company, Boston, Mass.: —
Bay State Fertilizer.
Bay State Fertilizer, G. G.
Great Planet Manure.
King Philip Guano.
Potato and Tobacco Fertilizer.
Fish and Potash.

Cleveland Dryer Company, Boston, Mass.: —
Cleveland Potato Phosphate.
Cleveland Superphosphate.

Cleveland Linseed Oil Company, Worcester, Mass. : —
Cleveland Steam-cooked Linseed Meal.

E. Frank Coe, New York, N. Y. : —
Excelsior Gold Brand Guano.
High-grade Ammoniated Bone Superphosphate.
Fish Guano and Potash.
Potato Fertilizer.

Crocker Fertilizer and Chemical Company, Buffalo, N. Y. : —
New Rival Ammoniated Superphosphate.
Ammoniated Bone Superphosphate.
Ammoniated Practical Superphosphate.
Vegetable Bone Superphosphate.
Buffalo Superphosphate, No. 2.
Wheat and Corn Phosphate.
Potato, Hop and Tobacco Phosphate.
Special Potato Manure.
Ground Bone Meal.
Pure Ground Bone.

Cumberland Bone Phosphate Company, Portland, Me. : —
Cumberland Superphosphate.
Potato Fertilizer.

L. B. Darling Fertilizer Company, Pawtucket, R. I. : —
Darling's Animal Fertilizer.
Darling's Fertilizer for Gardens and Lawns.
Darling's Potato and Root Crop Manure.
Darling's Tobacco Grower.
Darling's Extra Bone Phosphate.
Darling's Pure Dissolved Bone.
Darling's Pure Fine Bone.

J. C. Dow & Co., Boston, Mass. : —
Nitrogenous Superphosphate.
Ground Bone Fertilizer.
Ground Bone.

Forest City Wood Ash Company, London, Ont. : —
Hardwood Ashes.

Wm. E. Fyfe & Co., Clinton, Mass. : —
Canada Unleached Wood Ashes (Star Brand).

Great Eastern Fertilizer Company, Rutland, Vt. : —
Great Eastern General, for Grass and Grain.
Great Eastern Vegetable, Vine and Tobacco Fertilizers.
Great Eastern General, Oats, Buckwheat and Seeding-down Phosphate.

Hargraves' Manufacturing Company, Fall River, Mass. : —
Ground Bone.

Edmund Hersey, Hingham, Mass. : —
Ground Bone.

Thos. Hersom & Co., New Bedford, Mass. : —
Meat and Bone.
Pure Fine-ground Bone.

Gilbert E. Holmes, New Worcester, Mass. : —
Pure Ground Bone.

John G. Jefferds, Worcester, Mass. : —
Animal Fertilizer.
Potato Manure.
Fine-ground Bone.

J. J. Joynt, St. Helens, Ont. : —
Canada Unleached Hardwood Ashes.

A. Lee & Co., Boston, Mass. : —
Lawrence Fertilizer.
Ground Bone.

Lowell Bone Fertilizer Company, Lowell, Mass. : —
Lowell Bone Fertilizer.

James E. McGovern, West Andover, Mass. : —
West Andover Market Bone Phosphate.
Ground Bone.

Mapes Formula and Peruvian Guano Company, New York, N. Y. : —
Mapes Superphosphates.
Mapes Special Crop Manures.
Peruvian Guanos.
Bone Manures.
Sulphate of Potash.

Monroe, DeForest & Co., Oswego, N. Y. : —
Hardwood Ashes.

National Fertilizer Company, Bridgeport, Conn. : —
Chittenden's Complete Fertilizer.
Chittenden's Universal Phosphate.
Chittenden's Fish and Potash.
Ground Bone.
Sulphate of Potash.

Pacific Guano Company, Boston, Mass. : —
Soluble Pacific Guano.
Special Potato Manure.

Prentiss, Brooks & Co., Holyoke, Mass. : —
- Complete Manure.
- Phosphate.
- Dry Fish.
- Dissolved Bone-black.
- Nitrate of Soda.
- Muriate of Potash.

Quinnipiac Fertilizer Company, Boston, Mass. : —
- Quinnipiac Market-garden Manure.
- Quinnipiac Corn Manure.
- Quinnipiac Potato Manure.
- Quinnipiac Potato and Tobacco Fertilizer.
- Quinnipiac Havana and Seed-leaf Tobacco Fertilizer.
- Quinnipiac Onion Manure.
- Quinnipiac Phosphate.
- Quinnipiac Pure Bone Meal.
- Quinnipiac Dry Ground Fish.
- Quinnipiac Fish and Potash (c. f. Brand).
- Quinnipiac Fish and Potash (Plain Brand).
- Muriate of Potash.
- Sulphate of Potash.

Benjamin Randall, East Boston, Mass. : —
- Market-garden Fertilizer.
- Standard Ground Bone.

Read Fertilizer Company, Syracuse, N. Y. : —
- H. G. Farmers' Friend.
- Strawberry and Small Fruit Special.
- Read's Standard Phosphate.
- Bone, Fish and Potash (Fish and Potash).

John S. Reese & Co., Baltimore, Md. : —
- New England Favorite.
- May Flower.
- Columbus, A.
- Pilgrim.
- Potato Special.
- Fish and Potash.

Lucien Sanderson, New Haven, Conn. : —
- Sanderson's Formula A.
- Sanderson's Formula B.
- Sanderson's High-grade Sulphate of Potash.
- Sanderson's Regular Sulphate of Potash.

Edward H. Smith, Northborough, Mass. : —
- Steamed Bone.

Springfield Fertilizer Company, Springfield, Mass. : —
H. L. Phelps' Complete Manures.

Springfield Provision Company, Brightwood, Mass. : —
Blood, Meat and Bone.

Standard Fertilizer Company, Boston, Mass. : —
Standard Superphosphate.
Standard Fertilizer.
Standard Guano.
Potato and Tobacco Fertilizer.

F. C. Sturtevant, Hartford, Conn. : —
Tobacco and Sulphur Fertilizer.

J. A. Tucker & Co., Boston, Mass. : —
Original Bay State Bone Superphosphate.
Imperial Bone Superphosphate.

Whittemore Bros., Wayland, Mass. : —
Whittemore's Complete Manure.

Sanford Winter, Brockton, Mass. : —
Pure Ground Bone.

Leander Wilcox, Mystic, Conn. : —
Ammoniated Bone Phosphate.
High-grade Fish and Potash.
Potato, Onion and Tobacco Manure.
Dry Ground Fish.

William & Clark Fertilizer Company, Boston, Mass. : —
Ammoniated Bone Superphosphate.
Universal Ammoniated Dissolved Bone.
High-grade Special.
Potato and Tobacco Manure.
Fine Wrapper Tobacco Grower.
Potato Phosphate.
Corn Phosphate.
Pure Bone Meal.
Dry Ground Fish.
Fish and Potash.
Nitrate of Soda.
Muriate of Potash.
Sulphate of Potash.

4. Analyses of Licensed Fertilizers collected during 1892 in the General Markets by the Agent of the Massachusetts Agricultural Experiment Station.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
2	Special Tobacco Manure,	H. J. Baker & Bro., New York, N. Y.,	Northampton.
12	Dry Ground Fish,	Williams & Clark, Boston, Mass.,	Northampton.
34	Jefferds' Potato Manure,	John G. Jefferds, Worcester, Mass.,	Worcester.
40	Dry Fish Guano,	Bradley Fertilizer Company, Boston, Mass.,	North Amherst.
50	Fine-ground Dry Fish,	Bowker Fertilizer Company, Boston, Mass.,	Sunderland.
58	Jefferds' Potato Manure,	John G. Jefferds, Worcester, Mass.,	Hadley.
59	Jefferds' Animal Fertilizer,	John G. Jefferds, Worcester, Mass.,	Hadley.
87	Crocker's Wheat and Corn Phosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Lee.
90	Pacific Guano Company's Special Potato Manure,	W. D. Stewart, Boston, Mass.,	Pittsfield.
97	Crocker's Wheat and Corn Phosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	North Adams.
108	Bay State Fertilizer,	Clark's Cove Fertilizer Company, Boston, Mass.,	Dighton.
	Chemicals.		
32	Muriate of Potash,	Bowker Fertilizer Company, Boston, Mass.,	Worcester.
33	Nitrate of Soda,	Bowker Fertilizer Company, Boston, Mass.,	Worcester.
64	Nitrate of Soda,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
65	Muriate of Potash,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
75	Dissolved Bone-black,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
119	Muriate of Potash,	Bradley Fertilizer Company, Boston, Mass.,	New Bedford.
146	Nitrate of Soda,	Williams & Clark, Boston, Mass.,	Greenfield.
148	Muriate of Potash,	Williams & Clark, Boston, Mass.,	Greenfield.
	Bones.		
7	H. J. Baker & Bro.'s Raw Ground Bone,	H. J. Baker & Bro., New York, N. Y.,	Northampton.
24	H. J. Baker & Bro.'s Raw Ground Bone,	H. J. Baker & Bro , New York, N. Y.,	Springfield.
35	Jefferds' Fine-ground Bone,	John G. Jefferds, Worcester, Mass.,	Worcester.
37	Bartlett's Fine-ground Bone,	C. A. Bartlett, Worcester, Mass.,	Worcester.
60	Steamed Bone,	E. H. Smith, Northborough, Mass.,	Amherst.
161	Darling's Ground Bone,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Fitchburg.
	Wood Ashes.		
144	Canada Unleached Hardwood Ashes,	Monroe, DeForest & Co., Oswego, N. Y.,	South Deerfield.

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds. Found.	Nitrogen Guaranteed.	Phosphoric Acid in One Hundred Pounds. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in One Hundred Pounds. Found.	Potassium Oxide Guaranteed.	Mechanical Analysis. Fine.	Fine Med.	Med.	Coarse Med.
	Compound Fertilizers.																
2	Special Tobacco Manure,	8.52	4.36	4.53	5.12	.05	.20	5.37	-	5.17	4	9.56	10*				
12	Dry Ground Fish,	7.30	7.96	7.41—9.06	.18	3.56	4.09	7.83	7—8	3.74	-	-	-				
34, 58	Jefferds' Potato Manure,	7.74	2.48	2.47—3.30	4.81	5.68	3.74	14.23	15—17	10.49	10—12	6.09	5—6*				
40	Dry Fish Guano,	10.34	8.27	7.41—9.06	.82	3.30	3.17	7.29	7—9	4.12	-	-	-				
50	Fine-ground Dry Fish,	10.12	8.64	6.59—8.24	.61	3.97	2.61	7.19	7—8	4.58	-	-	-				
59	Jefferds' Animal Fertilizer,	11.30	2.95	2.47—3.30	4.38	14.17	4.63	23.18	16—18	18.55	11—13	3.16	2.50—3.50*				
87, 97	Crocker's Wheat and Corn Phosphate,	13.22	2.34	2—3	6.35	4.31	1.64	12.60	11—15	10.66	10—13	2.95	1.80—2.70*				
90	Special Potato Manure,	13.34	2.67	2.47—3.30	4.35	1.28	2.81	8.44	7—10	5.63	5—7	5.12	5—6				
108	Bay State Fertilizer,	13.03	2.68	2.47—3.30	7.57	2.51	2.61	12.69	10—14	10.08	9—12	2.26	2—3*				
	Chemicals.																
32, 65	Muriate of Potash,	1.94	-	-	-	-	-	-	-	-	-	50.65	50.34—53.70				
33, 64	Nitrate of Soda,	1.10	15.44	15.65—16.14	-	-	-	-	-	-	-	-	-				
75	Dissolved Bone-black,	13.73	-	-	16.67	.30	.23	17.22	-	16.97	16—17	-	-				
119	Muriate of Potash,	1.26	-	-	-	-	-	-	-	-	-	50.40	48—55				
146	Nitrate of Soda,	1.02	15.52	15.65—16.14	-	-	-	-	-	-	-	-	-				
148	Muriate of Potash,	1.04	-	-	-	-	-	-	-	-	-	51.10	50.54—53.70				
	Bones.																
7, 24	Fine Raw Ground Bone,	8.53	3.77	3.30—3.91	.19	7.27	17.97	25.43	22—26	7.46	-			42.84	56.30	.70	.16
35	Fine-ground Bone,	9.00	1.51	2.47—3.30	.31	13.02	16.58	29.91	27—30	13.33	-			64.20	31.05	4.75	-
37	Fine-ground Bone,	3.95	3.60	2.39	.82	10.74	13.41	24.97	27.35	11.56	-			55.92	33.00	10.01	1.07
60	Steamed Bone,	5.24	4.00	4.02	31	8.44	14.38	23.13	23.50	8.75	7.69			44.03	44.64	11.33	-
161	Fine-ground Bone,	3.40	2.84	2.47—3.30	.26	10.69	14.25	25.20	24—26	10.95	-			75.12	16.52	7.36	-
	Wood Ashes.											Potassium Oxide. Found.	Potassium Oxide. Guaranteed.				
144	Canada Unleached Hardwood Ashes,	11.27	-	-	-	-	-	1.30	1—2.50	-	-	5.42	4.50—7				

* Sulphate of potash, the source of potash.

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
56	Darling's Animal Fertilizer,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Sunderland.
179	High-grade Ammoniated Bone Superphosphate,	E. Frank Coe, New York, N. Y.,	Hadley.
141	Tobacco Manure (Wrapper Brand),	Mapes' Formula and Peruvian Guano Company, New York, N. Y.,	South Deerfield.
188	Blood, Meat and Bone,	Springfield Provision Company, Brightwood, Mass.,	Brightwood.
197	Potato, Onion and Tobacco Manure,	Leander Wilcox, Mystic, Conn.,	Holyoke.
101	Animal Fertilizer (Darling's),	L. B. Darling Company, Pawtucket, R. I.,	Worcester.
85	High-grade Ammoniated Bone Superphosphate,	E. Frank Coe, New York, N. Y.,	Lee.
94	Great Eastern Vegetable, Vine and Tobacco Fertilizer,	Great Eastern Fertilizer Company, Rutland, Vt.,	Pittsfield.
81	Potato Manure,	Quinnipiac Fertilizer Company, Boston, Mass.,	Springfield.
100	Onion Manure,	Quinnipiac Fertilizer Company, Boston, Mass.,	South Deerfield.
151	Standard Fertilizer,	Standard Fertilizer Company, Boston, Mass.,	Greenfield.
48	Cumberland Superphosphate,	Cumberland Bone Company, Portland, Me.,	Sunderland.
129	Ammoniated Practical Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
45	Potato Manure,	Quinnipiac Fertilizer Company, Boston, Mass.,	North Amherst.
26	Fish and Potash, D Brand,	Joseph Church & Co., Tiverton, R. I.,	Springfield.
153	May Flower,	John S. Reese & Co. Baltimore, Md.,	Greenfield.
18	Bradley's X. L. Superphosphate of Lime,	Bradley Fertilizer Company, Boston, Mass.,	Northampton.
106	Fish and Potash, D Brand,	Joseph Church & Co., Tiverton, R. I.,	Taunton.
103	Cleveland Potato Phosphate,	Cleveland Dryer Company, Cleveland, Ohio.,	So. Framingham.
42	Bradley's X. L. Superphosphate of Lime,	Bradley Fertilizer Company, Boston, Mass.,	North Amherst.
164	Superphosphate (Cumberland),	Cumberland Bone Company, Portland, Me.,	Lowell.
109	New England Favorite,	J. S. Reese & Co., Baltimore, Md.,	Dighton.
	Bones.		
86	Pure Ground Bone,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Lee.
128	Pure Ground Bone,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
120	Pure Fine-ground Bone,	Thos. Hersom & Co., New Bedford, Mass.,	New Bedford.
167	Pure Fine-ground Bone,	Thos. Hersom & Co., New Bedford, Mass.,	New Bedford.

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
56, 101	Darling's Animal Fertilizer,	18.27	3.40	3.30—4.90	4.55	2.62	4.50	11.67	10—12	7.17	-	4.49	4—6
179, 85	High-grade Ammoniated Bone Superphosphate,	11.37	2.34	2—2.50	7.23	1.41	2.43	11.07	11—13	8.64	9—12	2.24	2*
141	Tobacco Manure (Wrapper Brand),	8.57	6.02	6.18	.45	2.43	3.26	6.14	4.50	2.88	-	11.69	10.50*
188	Blood, Meat and Bone,	8.76	7.18	7.76	51	4.61	4.86	9.98	10.66	5.12	-	-	-
197	Potato, Onion and Tobacco Manure,	7.05	3.91	3.25—4.25	6.65	1.22	2.94	10.81	8—9	7.87	7—8	5.72	6—7
94	Great Eastern Vegetable, Vine and Tobacco Fertilizer,	13.90	2.14	2.06—2.88	7.04	1.15	1.34	9.53	9—15	8.19	8—12	6.10	6—8
81, 45	Potato Manure,	13.72	3.18	2.47—3.30	4.09	1.80	2.43	8.32	7—11	5.89	6—9	4.37	5—6*
100	Onion Manure,	10.52	3.65	3.30—4.12	6.22	5.22	1.25	12.69	9—13	11.44	8—11	6.50	7—8*
151	Standard Fertilizer,	10.46	2.11	2—3	7.06	2.21	2.81	12.08	10—15	9.27	8—12	2.16	2—3
48, 164	Cumberland Superphosphate,	11.64	2.20	2.06—2.88	8.39	1.28	2.56	12.23	10—12	9.67	8—10	2.28	2—3*
129	Ammoniated Practical Superphosphate,	11.62	1.27	.82—1.64	5.99	3.28	1.48	10.75	9—12	9.27	8—10	1.98	1—2*
26, 106	Fish and Potash, D Brand,	13.54	2.68	2.47—3.30	4.66	2.00	1.48	8.14	7.50—8.50	6.66	-	2.25	2—3
153	May Flower,	11.86	1.91	1.80—2.50	3.07	6.44	1.18	10.69	10—13	9.51	8.50—10	2.49	2.25—3
18, 42	Bradley's X. L. Superphosphate of Lime,	13.48	2.97	2.50—3.25	6.91	4.86	1.48	13.25	11—13	11.77	9—11	2.19	2—3*
103	Cleveland Potato Phosphate,	7.57	2.52	2.05—2.85	7.42	2.10	1.33	10.85	10—13	9.52	8—10	4.01	3—4*
109	New England Favorite,	17.54	2.58	2.47—3.30	3.84	7.16	.51	11.51	11—14	11.00	9—12	2.37	2—3
												Mechanical Analysis.	
	Bones.											Fine. / Fine Med.	Med. / Coarse Med.
86, 128	Pure Ground Bone,	7.48	3.51	2—3.70	.24	7.05	16.76	24.05	25.00	7.29	-	26.20 / 25.78	39.39 / 8.63
120, 167	Pure Fine-ground Bone,	4.27	1.68	2.08	.26	10.29	20.09	30.64	29.42	10.55	13.62	59.67 / 22.71	15.00 / 2.62

* Sulphate of potash, the source of potash.

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at—
	Compound Fertilizers.		
8	Ammoniated Bone Superphosphate (Americus Brand),	Williams & Clark Fertilizer Company, Boston, Mass.,	Northampton.
16	Bradley's High-grade Tobacco Manure,	Bradley Fertilizer Company, Boston, Mass.,	Northampton.
23	Bowker's Lawn and Garden Dressing,	Bowker Fertilizer Company, Boston, Mass.,	Springfield.
28	Tobacco and Sulphur Lawn Fertilizer,	F. C. Sturtevant, Hartford, Conn.,	Springfield.
31	Bowker's Lawn and Garden Dressing,	Bowker Fertilizer Company, Boston, Mass.,	Worcester.
41	High-grade Tobacco Manure,	Bradley Fertilizer Company, Boston, Mass.,	North Amherst.
43	Dry Ground Fish,	Quinnipiac Fertilizer Company, Boston, Mass.,	North Amherst.
67	High-grade Fish and Potash,	Leander Wilcox, Mystic, Conn ,	Amherst.
76	Complete Manure for Corn,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
83	Ammoniated Bone Superphosphate (Americus Brand),	Williams & Clark Fertilizer Company, Boston, Mass ,	Springfield.
96	Special Potato Manure,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	North Adams.
107	Clark's Cove Fish and Potash,	Clark's Cove Fertilizer Company, Boston, Mass.,	Dighton.
112	Columbus "A" Manure,	J. S. Reese & Co., Baltimore, Md.,	Dighton.
115	Market-garden Manure,	Quinnipiac Fertilizer Company, Boston, Mass.,	Fall River.
117	Potato, Tobacco and Hop Phosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Fall River.
124	Plymouth Rock Fertilizer,	Ames Fertilizer Company, Peabody, Mass.,	Amherst.
125	Dow's Nitrogenous Superphosphate,	John C. Dow & Co., Boston, Mass.,	Amherst.
133	Special Potato Manure,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
136	Potato, Hop and Tobacco Phosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
166	Lowell Bone Fertilizer,	J. M. Butman, Chelmsford, Mass.,	Chelmsford.
180	Red Brand Excelsior Guano,	E. Frank Coe, New York, N. Y.,	Hadley.
193	Market-garden Manure,	Quinnipiac Fertilizer Company, Boston, Mass.,	Northampton.
195	Columbus "A" Manure,	J. S. Reese & Co., Baltimore, Md.,	Springfield.
198	Complete Manure for Corn,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
	Bones.		
52	Fresh Ground Bone,	Bowker Fertilizer Company, Boston, Mass.,	Sunderland.
113	Ground Bone,	Hargraves' Manufacturing Company, Fall River, Mass.,	Fall River.
116	Ground Bone,	Hargraves' Manufacturing Company, Fall River, Mass.,	Fall River.
121	Pure Ground Bone,	S. Winter, Brockton, Mass.,	Brockton.
138	Pure Ground Bone,	S. Winter, Brockton, Mass.,	Amherst.
169	Fine-ground Bone,	Bryant & Brett, New Bedford, Mass.,	New Bedford.

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds. Found.	Nitrogen Guaranteed.	Phosphoric Acid in One Hundred Pounds. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in One Hundred Pounds. Found.	Potassium Oxide Guaranteed.
	Compound Fertilizers.												
8, 83	Ammoniated Bone Superphosphate (Americus Brand),	11.44	2.78	2.47—3.80	6.14	2.92	2.35	11.41	10—13	9.06	9—11	1.53	2—3*
16, 41	Bradley's High-grade Tobacco Manure,	7.32	5.92	5.77—6.59	2.25	1.02	3.28	6.55	4—5	3.27	-	10.31	10.80*
23, 31	Bowker's Lawn and Garden Dressing,	14.46	4.08	4.12—4.94	5.99	.05	5.22	11.26	6—8	6.04	5—6	5.03	5—6*
28	Tobacco and Sulphur Lawn Fertilizer,	12.72	1.94	1.96	trace	.25	.26	.51	.75	.25	-	8.34	7.66
43	Dry Ground Fish,	6.38	8.72	7.41—9.06	.77	3.48	2.30	6.55	7—9	4.25	-	-	-
67	High-grade Fish and Potash,	19.44	3.66	3.25—4.25	2.97	1.43	2.25	6.65	6—7	4.40	5—6	4.93	4—5
76, 198	Complete Manure for Corn,	13.92	3.36	3.30—4.12	4.75	.78	1.25	6.78	8—10	5.53	4—6	5.85	6—7
96, 133	Special Potato Manure,	11.95	3.90	3.70—4.50	5.68	1.48	2.51	9.67	9—11	7.16	8—9	5.45	5.40—6.40*
107	Clark's Cove Fish and Potash,	16.34	3.44	2.47—4.12	3.38	2.20	1.89	7.47	7—9	5.58	6—8	2.73	3—5*
112, 195	Columbus "A" Manure,	15.73	3.44	3.29—4.11	2.66	5.12	.77	8.55	8—11	7.78	7—9	9.06	9.50—11
115, 193	Market-garden Manure,	12.94	3.82	3.30—4.12	6.55	.87	2.66	10.08	9—13	7.42	8—11	6.98	7—8*
117, 136	Potato, Tobacco and Hop Phosphate,	15.01	2.56	2—3	7.42	7.17	1.41	16.00	11—14	14.59	10—12	3.87	3.25—4.30*
124	Plymouth Rock Fertilizer,	19.28	2.52	2.47—3.30	5.31	5.92	.19	11.42	9—13	11.23	8—10	3.52	3—4
125	Dow's Nitrogenous Superphosphate,	20.82	2.32	2.03—2.88	3.71	5.46	1.04	10.21	8—10	9.17	-	2.18	1.90—2.53
166	Lowell Bone Fertilizer,	13.97	2.48	2—2.50	5.76	6.01	.13	11.90	9—16.5	11.77	7—13.5	2.88	2—3.50
180	Red Brand Excelsior Guano,	12.82	3.14	3.50—4	7.16	1.86	1.02	10.04	10—14	9.02	9—12	6.47	6*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Mechanical Analysis. Fine.	Fine Med.	Med.	Coarse Med.
	Bones.														
52	Fresh Ground Bone,	4.89	3.40	2.47—3.30	1.05	6.62	10.75	18.42	18—22	7.67	5—7	39.96	29.04	24.50	6.50
113, 116	Ground Bone,	12.05	2.80	2.50—2.80	.32	11.45	13.87	25.66	25—27	11.77	-	21.28	37.86	18.48	22.38
121, 138	Pure Ground Bone,	5.82	3.32	3.66	.20	11.67	10.90	22.77	22.85	11.87	9.55	59.61	20.75	8 70	10.94
169	Pure Fine-ground Bone,	6.96	2.50	2.50	.10	7.06	18.40	25.56	25.56	7.16	7.16	17.69	20.74	19.90	41.67

* Sulphate of potash, the source of potash.

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
4	Complete Grass Manure,	H. J Baker & Bro., New York, N. Y.,	Northampton.
17	Bradley's Complete Manure for Potatoes and Vegetables,	Bradley Fertilizer Company, Boston, Mass.,	Northampton.
36	Animal Fertilizer,	C. A. Bartlett, Worcester, Mass.,	Worcester.
54	Ammoniated Bone Phosphate,	Bowker Fertilizer Company, Boston, Mass.,	Sunderland.
57	Potato and Root Crop Manure,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Sunderland.
74	Phosphate,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
82	Cleveland Steam-cooked Linseed Meal,	Cleveland Linseed Oil Company, Cleveland, Ohio,	Springfield.
91	Soluble Pacific Guano,	W. D. Stewart & Co., Boston, Mass. (Agent),	Pittsfield.
92	Chittenden's Ammoniated Bone Superphosphate,	National Fertilizer Company, Bridgeport, Conn.,	Pittsfield.
102	Potato and Root Crop Manure,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Worcester.
110	Dry Ground Fish,	Clark's Cove Fertilizer Company, Boston, Mass.,	Dighton.
118	Chittenden's Fish and Potash,	National Fertilizer Company, Bridgeport, Conn.,	New Bedford.
122	Whittemore's Complete Manure,	Whittemore Bros., Wayland, Mass.,	Wayland.
123	Animal Fertilizer,	Burgess & Roy, South Attleborough, Mass.,	Amherst.
130	Buffalo Superphosphate, No. 2,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
156	Standard Fertilizer,	Read Fertilizer Company, Syracuse, N. Y.,	Gardner.
157	Strawberry Special,	Read Fertilizer Company, Syracuse, N. Y.,	Gardner.
172	Lawrence Fertilizer,	A. Lee & Co., Boston, Mass.,	Lawrence.
173	West Andover Market Bone Phosphate,	J. E. McGovern, Lawrence, Mass.,	Lawrence.
183	Chittenden's Fish and Potash,	National Fertilizer Company, Bridgeport, Conn ,	Hadley.
199	Garden and Lawn Dressing,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Amherst.
	Chemicals.		
72	Muriate of Potash,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
73	Nitrate of Potash,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
140	Sulphate of Potash,	Mapes Formula and Peruvian Guano Company, New York, N. Y.,	South Deerfield.
147	Sulphate of Potash,	Williams & Clark, Boston, Mass.,	Greenfield.
175	Sulphate of Potash,	Bowker Fertilizer Company, Boston, Mass ,	Amherst.
176	Sulphate of Potash,	Bradley Fertilizer Company, Boston, Mass.,	North Amherst.
177	Muriate of Potash,	Quinnipiac Fertilizer Company, Boston, Mass.,	North Amherst.
178	Sulphate of Potash,	Quinnipiac Fertilizer Company, Boston, Mass.,	North Amherst.
184	Sulphate of Potash,	National Fertilizer Company, Bridgeport, Conn.,	Hadley.
	Wood Ashes.		
98	Canada Unleached Hardwood Ashes,	J. J. Joynt, St. Helens, Ont.,	South Deerfield.
139	Wood Ashes,	Forest City Wood Ash Company, London, Ont.,	South Deerfield.

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds. Found.	Nitrogen Guaranteed.	Phosphoric Acid in One Hundred Pounds. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in One Hundred Pounds. Found.	Guaranteed.
	Compound Fertilizers.												
4	Completo Grass Manure,	16.18	3.50	3.71	4.20	1.43	.23	5.86	–	5.63	5	8.17	7.50
17	Bradley's Com. Manure for Potatoes and Veg.,	10.20	3.98	3.75—4.50	6.91	1.93	1.02	9.86	9—12	8.84	8—11	7.69	6—7*
36	Animal Fertilizer,	6.42	3.72	3.30—4.12	3.07	3.57	5.76	12.40	16—18	6.64	–	7.73	7—8
54	Ammoniated Bone Phosphate,	12.42	1.88	1.65—2.47	5.65	3.09	2.39	11.13	10—12	8.74	8—10	2.13	2—3
57, 102	Potato and Root Crop Manure,	13.55	2.36	2.88—4.12	4.09	3.33	2.56	9.98	10—12	7.42	–	7.66	7—9
74	Phosphate,	11.94	2.70	2.47—3.30	6.58	1.84	2.43	10.85	8—10	8.42	–	3.04	3—4
82	Cleveland Steam-cooked Linseed Meal,	10.85	5.95	5.80—6.20	–	–	–	2.00	1.998—2.20	–	–	1.36	1.30—1.50
91	Soluble Pacific Guano,	16.82	2.40	2.25—4.00	6.66	2.93	2.05	11.64	10.50—16	9.59	8.50—12	3.15	2—3.50*
92	Chittenden's Ammoniated Bone Superphos.,	10.72	2.44	1.65—2.47	7.83	2.10	2.15	12.08	9—11	9.93	7—9	3.27	2—4
110	Dry Ground Fish,	7.82	7.16	7.41—9.06	.97	2.67	3.58	7.22	7—9	3.64	–	–	–
118, 183	Chittenden's Fish and Potash,	6.26	3.00	3.30—4.12	1.57	2.05	5.28	8.90	6—8	3.62	–	6.20	5—6
122	Whittemore's Complete Manure,	11.76	3.62	2.47—3.30	6.19	5.81	3.88	15.88	12—14	12.00	8—12	2.79	3—4
123	Animal Fertilizer,	4.00	4.20	2.47—4.12	.20	4.66	12.64	17.50	12—15	4.86	10—12	4.99	3—5
130	Buffalo Superphosphate, No. 2,	18.10	–	–	10.39	1.16	1.60	13.15	12—15	11.55	11—13	2.62	1.35—2*
156	Standard Fertilizer,	12.60	1.08	.82—1.65	5.42	2.25	.26	7.93	10—12	7.67	8—10	4.49	4—6*
157	Strawberry Special,	16.37	3.10	3.30—4.94	3.45	2.30	1.15	6.90	6—8	5.75	5—6	7.43	6—8*
172	Lawrence Fertilizer,	9.88	2.30	2.06—2.88	3.88	7.98	2.16	14.02	12	11.86	–	4.24	2—3
173	West Andover Market Bone Phosphate,	11.50	1.62	2.50—3.50	4.35	8.66	4.73	17.74	13—15	13.01	6—8	1.50	4—6
199	Garden and Lawn Dressing,	7.06	3.82	4—6	4.66	1.99	3.79	10.44	10—12	6.65	–	6.49	5—6
	Chemicals.												
72	Muriate of Potash,	.60	–	–	–	–	–	–	–	–	–	51.65	50.54—53.70
73	Nitrate of Soda,	1.72	13.88	14.82—15.52	–	–	–	–	–	–	–	–	–
140	Sulphate of Potash,	8.50	–	–	–	–	–	–	–	–	–	26.92	25.94—28.10*
147	Sulphate of Potash,	4.50	–	–	–	–	–	–	–	–	–	24.90	25.94—27.02*
175	Sulphate of Potash,	.65	–	–	–	–	–	–	–	–	–	49.60	48—52*
176	Sulphate of Potash,	3.42	–	–	–	–	–	–	–	–	–	26.35	25.94—27.02*
177	Muriate of Potash,	1.77	–	–	–	–	–	–	–	–	–	51.36	50.54—53.70
178	Sulphate of Potash,	4.82	–	–	–	–	–	–	–	–	–	25.78	25.94—27.02*
184	Sulphate of Potash,	4.53	–	–	–	–	–	–	–	–	–	24.15	25.94—27.02*
	Wood Ashes.												
98	Canada Unleached Hardwood Ashes,	13.10	–	–	–	–	–	1.77	–	–	–	4.72	5—7
139	Wood Ashes,	15.75	–	–	–	–	–	1.33	1.50—2.50	–	–	5.44	4.50—8.50

* Sulphate of potash, the source of potash.

4. ANALYSES OF LICENSED FERTILIZERS, ETC. — *Continued.*

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
1	Pelican Bone Standard Fertilizer,	H. J. Baker & Bro., New York, N. Y.,	Northampton.
5	Potato Manure,	H. J. Baker & Bro., New York, N. Y.,	Northampton.
10	Potato Phosphate,	Williams & Clark, Boston, Mass.,	Northampton.
15	Mapes' Manure for Potatoes,	Mapes Formula and Peruvian Guano Company, New York, N. Y.,	Northampton.
27	Pure Dry Fish A Brand,	Joseph Church & Co., Tiverton, R. I.,	Springfield.
30	Bradley's Complete Manure for Top-dressing Grass, etc.,	Bradley Fertilizer Company, Boston, Mass.,	Worcester.
39	Fish and Potash, Brand B,	Bradley Fertilizer Company, Boston, Mass.,	North Amherst.
44	Fish and Potash (Crossed Fish Brand),	Quinnipiac Fertilizer Company, Boston, Mass.,	North Amherst.
46	Corn Manure,	Quinnipiac Fertilizer Company, Boston, Mass.,	North Amherst.
47	Potato and Tobacco Fertilizer,	Quinnipiac Fertilizer Company, Boston, Mass.,	North Amherst.
61	Dried Blood,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
62	Dissolved Bone-black,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
68	Dry Ground Fish Guano,	Leander Wilcox, Mystic, Conn.,	Amherst.
79	Quinnipiac Phosphate,	Quinnipiac Fertilizer Company, Boston, Mass.,	Springfield.
80	Fish and Potash (Crossed Fish Brand),	Quinnipiac Fertilizer Company, Boston, Mass.,	Springfield.
84	Potato Phosphate,	Williams & Clark, Boston, Mass.,	Springfield.
89	Pelican Bone Standard Fertilizer,	H. J. Baker & Bro., New York, N. Y.,	Pittsfield.
104	Cleveland Superphosphate,	Cleveland Dryer Company, Cleveland, Ohio,	So. Framingham.
111	Great Planet A Manure, Potatoes, Onions, etc.,	Clark's Cove Company, Boston, Mass.,	Dighton.
114	Mapes' Manure for Potatoes,	Mapes Formula and Peruvian Guano Company, New York, N. Y.,	Fall River.
127	Ground Bone Fertilizer,	John C. Dow & Co., Boston, Mass.,	Amherst.
132	New Rival Ammoniated Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
154	Fish and Potash,	John S. Reese & Co., Baltimore, Md.,	Greenfield.
181	High-grade Fish and Potash,	E. Frank Coe, New York, N. Y.,	Hadley.
189	The H. L. Phelps Fish and Potash,	Springfield Fertilizer Company, Springfield, Mass.,	Springfield.
190	The H. L. Phelps Complete Manure for Potatoes and Vegetables,	Springfield Fertilizer Company, Springfield, Mass.,	Springfield.
192	Adams Market Bone Phosphate,	Adams & Thomas, Springfield, Mass.,	Springfield.
200	Tobacco Grower,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Amherst.
202	Dissolved Bone,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Amherst.
203	Potato Special,	J. S. Reese & Co., Baltimore, Md.,	Springfield.
	Bones.		
126	Ground Bone,	John C. Dow & Co., Boston, Mass.,	Amherst.
131	Ground Bone Meal,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
158	Ground Bone Meal,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Fitchburg.
168	Meat and Bone,	Thomas Hersom & Co., New Bedford, Mass.,	New Bedford.
171	Pure Ground Bone,	William Lavery, Amesbury, Mass.,	Amesbury.
174	Ground Bone,	J. E. McGovern, Lawrence, Mass.,	West Andover.

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds. Found.	Nitrogen in One Hundred Pounds. Guaranteed.	Phosphoric Acid in One Hundred Pounds. Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Potassium Oxide in One Hundred Pounds. Found.	Potassium Oxide in One Hundred Pounds. Guaranteed.
	Compound Fertilizers.												
1, 89	Pelican Bone Standard Fertilizer,	16.60	2.04	1.85—2.27	6.02	3.20	1.02	10.24	-	9.22	8—10	2.94	2.25—3
5	Potato Manure,	9.70	3.98	3.30	3.68	2.13	.92	6.73	-	5.81	5.75	9.97	10
10, 84	Potato Phosphate,	15.55	2.92	2.47—3.30	5.65	1.08	2.05	8.78	7—11	6.73	6—9	5.99	5—6*
15, 114	Mapes' Manure for Potatoes,	11.62	3.46	3.71—4.12	7.04	1.26	.52	8.82	8—10	8.30	8	8.16	6—8*
27	Pure Dry Fish,	9.25	8.66	8.24—9.89	.64	3.25	4.91	8.80	6.87-11.45	3.89	-	-	-
30	Bradley's Complete Manure for Grass,	7.75	4.80	4.95—5.78	1.40	3.58	1.80	6.78	6—8	4.98	5—7	2.88	2.6—3.5*
39	Fish and Potash,	15.85	2.84	2.48—3.50	5.12	1.90	1.16	8.18	7.5—9.5	7.02	6—8	2.14	2—3*
44, 80	Fish and Potash (Crossed Fish Brand),	15.06	3.46	3.30—4.12	3.86	1.65	2.51	8.02	5—8	5.51	3—5	3.49	3—5*
46	Corn Manure,	17.72	2.62	2.06—2.88	6.01	4.35	1.92	12.28	10—14	10.36	9—12	1.63	1.5—2.5*
47	Potato and Tobacco Manure,	14.63	2.66	2.06—2.88	5.67	1.74	2.62	10.03	9—13	8.41	8—11	3.26	3—4*
61	Dried Blood,	9.12	8.96	8.24—9.89	-	-	-	-	-	-	-	-	-
62	Dissolved Bone-black,	16.29	-	-	14.33	.96	.06	15.35	-	15.29	15—18	-	-
68	Dry Ground Fish Guano,	10.02	9.02	8—10	.64	3.71	3.20	7.55	-	4.35	4—6	-	-
79	Quinnipiac Phosphate,	11.55	2.44	2.47—3.30	5.17	5.70	3.20	14.07	10—14	10.87	9—12	2.31	2—3*
104	Cleveland Superphosphate,	12.23	2.52	2.05—2.85	4.81	4.45	2.00	11.26	11—14	9.26	9—11	2.44	2—3*
111	Great Planet A Manure, Potatoes, Onions, etc.,	12.27	3.40	3.30—4.12	6.02	.76	2.18	8.96	9—13	6.78	8—11.5	7.23	7—8*
127	Ground Bone Fertilizer,	8.25	2.00	2.06—2.47	.31	7.20	12.68	20.19	18—22	7.51	-	3.17	3—3.5
132	New Rival Ammoniated Superphosphate,	15.77	2.30	1.2—2	8.44	2.18	1.15	11.77	11—15	10.62	10—12	1.74	1.6—2.7*
154	Fish and Potash,	12.45	2.68	2.47—4.11	4.99	2.56	1.92	9.47	7—10	7.55	6.5—8	4.27	3—5
181	High-grade Fish and Potash,	16.01	3.34	3.3—4.1	2.60	2.91	2.51	8.02	7—11	5.51	6—9	2.68	2.75*
189	The H. L. Phelps Fish and Potash,	9.45	3.72	3.30—4.12	1.80	2.04	2.30	6.14	4—7	3.84	-	4.44	4—6
190	The H. L. Phelps Complete Man. for Pot. & Veg.,	8.12	3.32	4.12—4.94	3.22	2.25	1.18	6.65	6—8	5.47	5—6	7.69	8—10
192	Adams Market Bone Phosphate,	6.78	2.86	2.5—3.5	.47	5.47	10.00	15.94	8—10	5.94	6—8	4.96	3—5
200	Tobacco Grower,	8.27	4.44	4.94—5.77	2.68	2.94	2.18	7.80	10—12	5.62	-	11.34	10—12
202	Dissolved Bone,	14.10	2.32	1.65—2.47	9.08	6.27	1.66	17.01	21—23	14.97	14—16	-	-
203	Potato Special,	15.22	3.10	2.97—3.80	2.30	5.38	.64	8.32	-	7.68	6—8	8.04	7.5—9.5

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available Found.	Available Guaranteed.	Mechanical Analysis. Fine.	Fine Med.	Med.	Coarse Med.
	Bones.														
126	Ground Bone,	3.55	2.08	1.65—2.47	.13	7.04	18.93	26.10	24—26	7.17	-	54.36	45.42	.22	-
131, 158	Ground Bone Meal,	6.75	1.98	2—3	-	10.44	19.18	29.62	25—28	10.44	-	85.95	10.13	3.92	-
168	Meat and Bone,	4.75	3.90	4.24	.26	6.39	13.69	20.34	19.52	6.65	6.73	52.74	33.14	11.70	2.42
171	Pure Ground Bone,	9.47	2.90	-	-	3.43	12.15	15.58	-	3.43	-	47.42	30.41	18.37	3.80
174	Ground Bone,	11.70	2.60	-	-	11.65	13.69	25.34	-	11.65	-	52.10	24.24	17.58	6.08

* Sulphate of potash, the source of potash.

4. Analyses of Licensed Fertilizers, etc. — *Continued.*

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
6	A. A. Ammoniated Superphosphate,	H. J. Baker & Bro., New York, N. Y.,	Northampton.
11	Fish and Potash,	Williams & Clark, Boston, Mass.,	Northampton.
14	Mapes' Grass and Grain, Spring Top Dressing,	Mapes Formula and Peruvian Guano Company, New York, N. Y.,	Northampton.
20	Chittenden's Complete Fertilizer for Potatoes, Roots and Vegetables,	National Fertilizer Company, Bridgeport, Conn.,	Northampton.
22	Stockbridge Special Potato Manure,	Bowker Fertilizer Company, Boston, Mass.,	Springfield.
25	A. A. Ammoniated Superphosphate,	H. J. Baker & Bro., New York, N. Y.,	Springfield.
29	Hill and Drill Phosphate,	Bowker Fertilizer Company, Boston, Mass ,	Worcester.
38	Bradley's Potato Manure,	Bradley Fertilizer Company, Boston, Mass.,	North Amherst.
53	Stockbridge Manure for Potatoes and Vegetables,	Bowker Fertilizer Company, Boston, Mass.,	Sunderland.
55	Hill and Drill Phosphate,	Bowker Fertilizer Company, Boston, Mass.,	Sunderland.
69	Williams & Clark's Corn Phosphate (Americus Brand),	Williams & Clark, Boston, Mass.,	Amherst.
70	Ammoniated Bone Phosphate, No. 1,	Leander Wilcox, Mystic, Conn.,	Amherst.
77	Ground Scrap,	Ellsworth, Tuthill & Co.,	Holyoke.
95	Chittenden's Complete Fertilizer for Potatoes, Roots and Vegetables,	National Fertilizer Company, Bridgeport, Conn.,	Pittsfield.
99	Tobacco Fertilizer,	Quinnipiac Fertilizer Company, Boston, Mass.,	South Deerfield.
135	Ammoniated Bone Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
137	Vegetable Bone Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Amherst.
143	Manure for Light Soils,	Mapes Formula and Peruvian Guano Company, New York, N. Y.,	South Deerfield.
145	Gloucester Fish and Potash,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
149	Fine Wrapper Tobacco Grower,	Williams & Clark, Boston, Mass.,	Greenfield.
152	Complete Manure for Corn and Grain,	Bradley Fertilizer Company, Boston, Mass.,	Greenfield.
155	Samson Fertilizer,	Read Fertilizer Company, Syracuse, N. Y.,	Gardner.
159	Vegetable Bone Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Fitchburg.
162	English Lawn Dressing,	Bradley Fertilizer Company, Boston, Mass.,	Lowell.
163	Farmer's New Method Fertilizer,	Bradley Fertilizer Company, Boston, Mass.,	Lowell.
165	Cumberland Potato Fertilizer,	Cumberland Bone Phosphate Company, Portland, Me.,	Lowell.
182	Ground Fish,	E. Frank Coe, New York, N. Y.,	Hadley.
185	Chittenden's Complete Fertilizer for Potatoes, Roots and Vegetables,	National Fertilizer Company, Bridgeport, Conn.,	Hadley.
186	Farm and Garden Phosphate,	Bowker Fertilizer Company, Boston, Mass.,	Northampton.
187	Square Brand Fish and Potash,	Bowker Fertilizer Company, Boston, Mass.,	Northampton.
194	Havana and Seed-leaf Tobacco Fertilizer,	Quinnipiac Fertilizer Company, Boston, Mass.,	Northampton.
201	Extra Bone Phosphate,	L. B. Darling Fertilizer Company, Pawtucket, R. I.,	Amherst.

4. Analyses of Licensed Fertilizers, etc. — *Concluded.*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Total. Found.	Total. Guaranteed.	Available. Found.	Available. Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
6, 25	A. A. Ammoniated Superphosphate,	6.42	3.08	2.47—3.30	7.93	3.12	-	11.05	11—15	11.05	10—12	3.66	2—3
11	Fish and Potash,	8.92	3.46	3.30—4.12	3.07	2.22	2.51	7.80	6—8	5.29	3—5	3.48	3—5*
14	Mapes' Grass and Grain Spring Top Dressing,	11.27	5.00	4.12—5.77	5.88	1.93	1.15	8.96	7—9	7.81	5—7	6.68	5—7
20, 95, 185	Chittenden's Complete Fertilizer for Potatoes, Roots and Vegetables,	8.52	3.98	3.30—4.12	3.71	5.12	2.56	11.39	8—10	8.83	6—8	6.66	6—8
22	Stockbridge Special Potato Manure,	11.15	3.70	3.25—4.25	4.81	3.74	2.66	11.21	8—10	8.55	7—8	6.68	5—6
29, 55	Hill and Drill Phosphate,	14.10	2.72	2.50—3.25	5.88	5.12	1.92	12.92	12—14	11.00	8—10	1.95	2—3
38	Bradley's Potato Manure,	13.49	3.00	2.50—3.25	2.97	3.32	3.28	9.57	8—11	6.29	6—8	5.41	5—6*
53	Stockbridge Manure for Potatoes and Vegetables,	10.85	3.36	3.25—4.25	5.09	2.82	2.58	10.49	8—10	7.91	7—8	6.93	5—6
69	Williams & Clark's Corn Phosphate,	14.47	2.48	2.06—2.88	6.52	2.95	1.92	11.39	10.50—14	9.47	9—12	2.13	1.50—2.50*
70	Ammoniated Bone Phosphate, No. 1,	15.95	3.27	2.50—3.50	3.20	2.55	2.05	7.80	7—8	5.75	6—7	5.25	5—6
77	Ground Scrap,	9.45	9.21	8.24	.13	3.58	3.20	6.91	6	3.71	-	-	-
99	Tobacco Fertilizer,	7.00	6.53	5.77	1.66	3.07	1.92	6.65	9—13	4.73	5	10.83	10*
135	Ammoniated Bone Superphosphate,	14.15	3.71	2.90—3.70	9.59	1.66	.90	12.15	11—14	11.25	10—12	1.93	1—2*
137, 159	Vegetable Bone Superphosphate,	13.65	5.24	5—6	5.38	1.28	1.02	7.68	7—9	6.66	6—7	8.48	6—8*
143	Manure for Light Soils,	9.97	4.90	4.94—6.59	4.96	2.54	2.17	9.67	8—10	7.50	6—8	6.77	6—8
145	Gloucester Fish and Potash,	11.26	.94	.82—1.65	8.98	1.21	4.96	15.15	9—11	10.19	6—9	3.71	1—2*
149	Fine Wrapper Tobacco Grower,	7.45	5.54	5.77—6.59	1.43	2.48	2.05	5.96	6—9	3.91	5—7	11.97	10—12*
152	Complete Manure for Corn and Grain,	12.82	3.12	2.89—3.91	6.27	3.06	1.54	10.87	9—12	9.33	8—10	4.02	3—4*
155	Samson Fertilizer,	15.45	2.42	2.47—3.30	6.66	1.79	.51	8.96	9—12	8.45	8—10	6.20	5—6*
162	English Lawn Dressing,	8.72	5.35	4.95—5.70	2.04	3.34	1.02	6.40	6—9	5.38	5—7	4.63	2.50—3.50*
163	Farmers' New Method Fertilizer,	14.07	1.30	.82—1.65	5.62	2.96	2.30	10.88	10—12	8.58	8—10	3.80	2.16—3.24*
165	Cumberland Potato Fertilizer,	13.05	2.52	2.06—2.88	7.42	2.82	1.15	11.39	11—13	10.24	9—11	4.80	3—4*
182	Ground Fish,	10.57	8.32	8.24—9.06	.51	3.20	3.33	7.04	-	3.71	-	-	-
186	Farm and Garden Phosphate,	13.42	1.93	2—3	5.01	3.63	1.59	10.23	10—12	8.64	8—10	2.73	2—3
187	Square Brand Fish and Potash,	3.85	1.92	2.25—3.25	5.04	1.64	5.68	12.36	8—10	6.68	-	4.83	4—6
194	Havana and Seed-leaf Tobacco Fertilizer,	7.17	5.98	5.77—6.59	4.86	.64	.77	6.27	6—9	5.50	5—7	11.87	10—12*
201	Extra Bone Phosphate,	14.75	2.76	2.47—3.30	4.73	2.94	4.61	12.28	10—12	7.67	7—9	4.46	3—5

* Sulphate of potash, the source of potash.

5. Analyses of Commercial Fertilizers and Manurial Substances sent on for Examination.

Wood Ashes.

[I., sent on from Amherst, Mass.; II. and III., sent on from Lawrence, Mass.; IV., sent on from Hudson, Mass.; V., sent on from Clifton, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	13.18	16.12	8.71	18.00	15.94
Potassium oxide,	4.56	3.94	5.77	4.51	4.71
Calcium oxide,	34.06	30.38	36.95	33.25	31.65
Magnesium oxide,	2.88	2.64	2.90	1.84	2.59
Ferric and aluminic oxides,	1.32	1.32	0.07	1.42	1.62
Phosphoric acid,	1.66	1.52	1.38	1.18	1.43
Insoluble matter (before calcination),	13.60	17.52	13.15	12.99	13.38
Insoluble matter (after calcination),	11.16	13.10	11.88	10.84	10.62

Wood Ashes.

[I., sent on from South Framingham, Mass.; II. and III., sent on from Townsend, Mass.; IV., sent on from South Sudbury, Mass.; V., sent on from Rock Bottom, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	9.68	13.40	5.28	8.00	1.54
Potassium oxide,	5.48	4.36	5.75	5.41	5.14
Calcium oxide,	37.02	31.25	29.85	38.83	38.64
Magnesium oxide,	3.30	3.81	2.23	3.31	4.18
Ferric and aluminic oxides,	1.09	0.07	1.68	1.00	1.48
Phosphoric acid,	1.26	1.28	2.00	1.27	2.17
Insoluble matter (before calcination),	14.81	18.17	23.03	14.95	15.23
Insoluble matter (after calcination),	12.41	14.50	19.82	11.95	12.43

5. Analyses, etc. — *Continued.*

Wood Ashes.

[I., sent on from Clifton, Mass.; II., sent on from Beverly, Mass.; III., sent on from Hadley, Mass.; IV., sent on from Amherst, Mass.; V., sent on from Marblehead, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	17.44	6.63	15.09	6.68	1.38
Potassium oxide,	5.06	4.12	4.35	5.85	4.81
Calcium oxide,	31.32	42.84	32.87	35.70	28.44
Magnesium oxide,	1.48	2.20	2.89	3.83	2.26
Ferric and aluminic oxides,	0.51	0.45	1.45	0.82	1.66
Phosphoric acid,	1.39	0.84	1.69	1.65	3.47
Insoluble matter (before calcination),	13.80	13.92	14.60	11.54	33.08
Insoluble matter (after calcination),	10.46	12.43	12.07	9.13	26.78

Wood Ashes.

[I., sent on from Tewksbury, Mass.; II. and III., sent on from Sunderland, Mass.; IV. and V., sent on from North Amherst, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	13.90	17.54	3.50	7.46	14.15
Potassium oxide,	6.58	3.15	2.72	7.91	6.95
Calcium oxide,	33.81	29.66	21.23	38.58	31.88
Magnesium oxide,	2.19	3.28	2.39	2.59	1.73
Ferric and aluminic oxides,	1.10	2.62	2.14	0.65	1.25
Phosphoric acid,	1.74	1.87	1.65	1.25	1.42
Insoluble matter (before calcination),	10.00	17.90	44.80	8.11	11.10
Insoluble matter (after calcination),	8.65	12.98	39.69	6.04	8.99

5. Analyses, etc. — *Continued.*

Wood Ashes.

[I., sent on from Sunderland, Mass.; II., sent on from North Hatfield, Mass.; III., sent on from Chicopee, Mass.; IV., sent on from Concord, Mass.; V., sent on from Millington, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	7.80	16.74	15.70	18.67	1.02
Potassium oxide,	4.44	5.24	4.67	4.90	7.78
Calcium oxide,	–*	33.41	–*	–*	–*
Magnesium oxide,	–*	3.40	–*	–*	–*
Ferric and aluminic oxides,	–*	0.91	–*	–*	–*
Phosphoric acid,	1.79	1.54	1.77	1.68	2.84
Insoluble matter (before calcination),	11.98	10.97	7.72	12.18	13.50
Insoluble matter (after calcination),	9.54	8.65	7.27	9.83	12.55

Wood Ashes.

[I., sent on from Boston, Mass.; II. and III., sent on from Sunderland, Mass.; IV. and V., sent on from Concord, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	9.78	3.94	17.82	11.81	16.20
Potassium oxide,	8.13	4.96	4.04	5.77	5.02
Calcium oxide,	36.77	–*	–*	–*	31.64
Magnesium oxide,	3.24	*	–*	–*	3.03
Ferric and aluminic oxides,	0.36	–*	–*	–*	0.74
Phosphoric acid,	1.60	2.28	1.71	1.68	1.65
Insoluble matter (before calcination),	8.38	23.86	10.56	11.72	11.03
Insoluble matter (after calcination),	6.58	23.42	8.80	9.23	9.07

* Not determined.

5. Analyses, etc. — *Continued.*

Wood Ashes.

[I., sent on from Boston, Mass.; II., sent on from South Deerfield, Mass.; III., sent on from North Amherst, Mass.; IV., sent on from Concord, Mass.; V., sent on from Sunderland, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	10.41	7.05	19.63	10.49	12.60
Potassium oxide,	8.05	6.47	4.10	6.02	5.19
Calcium oxide,	36.10	40.54	33.67	32.42	31.53
Magnesium oxide,	3.17	2.84	1.76	3.60	2.31
Ferric and aluminic oxides,	0.59	0.75	1.06	0.65	1.11
Phosphoric acid,	1.68	1.56	1.61	1.55	1.59
Insoluble matter (before calcination),	8.39	9.08	12.33	11.37	17.15
Insoluble matter (after calcination),	6.49	6.45	10.26	8.37	14.42

Wood Ashes.

[I., sent on from Boston, Mass.; II. and III., sent on from Sunderland, Mass.; IV., sent on from South Deerfield, Mass.; V., sent on from Sudbury, Mass]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	10.46	16.55	25.50	10.40	13.95
Potassium oxide,	5.08	3.36	3.54	4.60	4.04
Calcium oxide,	33.83	27.67	31.29	33.97	27.98
Magnesium oxide,	3.19	1.84	2.14	2.93	4.43
Ferric and aluminic oxides,	0.78	0.94	0.60	1.35	1.59
Phosphoric acid,	1.46	1.54	1.41	1.29	1.51
Insoluble matter (before calcination),	15.76	15.78	14.91	15.03	18.45
Insoluble matter (after calcination),	11.77	13.03	10.29	10.88	12.96

5. Analyses, etc. — *Continued.*

Wood Ashes.

[I., sent on from South Deerfield, Mass.; II., sent on from Sudbury, Mass.; III., sent on from Hingham, Mass.; IV., sent on from Andover, Mass; V., sent on from Byfield, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	1.80	18.25	4.95	38.93	20.12
Potassium oxide,	6.19	3.36	5.64	2.34	6.70
Calcium oxide,	40.00	30.49	33.17	24.15	33.03
Magnesium oxide,	3.21	2.52	–*	–*	–*
Ferric and aluminic oxides,	1.44	1.22	–*	–*	–*
Phosphoric acid,	2.24	1.30	1.28	0.74	1.21
Insoluble matter (before calcination),	11.63	16.97	26.04	5.37	5.30
Insoluble matter (after calcination),	8.72	14.29	22.98	4.40	4.25

* Not determined.

Wood Ashes.

[I., sent on from Methuen, Mass.; II., sent on from Amesbury, Mass.; III., sent on from Readville, Mass.; IV., sent on from Amherst, Mass.; V., sent on from Sudbury, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	20.92	19.17	20.60	17.50	20.52
Potassium oxide,	3.28	3.56	4.82	4.08	3.80
Calcium oxide,	31.60	26.80	33.60	33.40	31.20
Magnesium oxide,	2.95	3.13	2.85	4.46	3.20
Ferric and aluminic oxides,	1.14	2.02	1.05	1.70	1.32
Phosphoric acid,	1.34	1.47	1.40	1.54	0.90
Insoluble matter (before calcination),	17.04	21.55	13.62	16.28	11.36
Insoluble matter (after calcination),	14.43	18.46	12.21	13.44	9.14

5. Analyses, etc. — *Continued.*

Wood Ashes.

[I., sent on from Waltham, Mass.; II., sent on from Hadley, Mass.; III. and IV., sent on from Boston, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	12.58	14.39	9.04	18.90
Potassium oxide,	4.48	3.72	4.38	2.61
Calcium oxide,	33.12	34.12	27.94	37.90
Magnesium oxide,	–*	–*	–*	3.39
Ferric and aluminic oxides,	–*	–*	–*	1.47
Phosphoric acid,	1.34	1.36	1.16	1.16
Insoluble matter (before calcination),	18.68	12.02	27.29	8.92
Insoluble matter (after calcination),	17.55	9.34	23.45	7.15

Cotton-hull Ashes.

[I., sent on from Sunderland, Mass.; II. and III., sent on from Hatfield, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	8.55	5.19	5.44
Potassium oxide,	26.68	32.28	12.03
Calcium oxide,	6.27	–*	6.24
Magnesium oxide,	8.48	–*	5.23
Ferric and aluminic oxides,	0.92	–*	4.93
Phosphoric acid,	8.55	7.42	6.12
Insoluble matter (before calcination),	18.93	27.15	45.82
Insoluble matter (after calcination),	15.65	–*	34.86

* Not determined.

5. Analyses, etc. — *Continued.*

Cotton-hull Ashes.

[Three samples, sent on from Agawam, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	7.71	4.20	4.58
Potassium oxide,	17.22	21.95	21.75
Calcium oxide,	5.93	9.46	9.66
Magnesium oxide,	8.13	11.50	10.95
Ferric and aluminic oxides,	–*	4.02	3.29
Phosphoric acid,	5.63	10.50	10.56
Insoluble matter (before calcination),	33.55	19.25	19.20
Insoluble matter (after calcination),	30.94	16.62	16.27

* Not determined.

Ivory Ashes.

[Sent on from Springfield, Mass.]

	Per Cent.
Moisture at 100° C.,	1.75
Potassium oxide,	2.44
Calcium oxide,	2.70
Magnesium oxide,	0.83
Ferric and aluminic oxides,	2.33
Total phosphoric acid,	2.05
Soluble phosphoric acid,	0.19
Insoluble matter (before calcination),	89.14
Insoluble matter (after calcination),	71.48

Lime-kiln Ashes.

[Sent on from Sunderland, Mass.]

	Per Cent.
Moisture at 100° C.,	0.00
Potassium oxide,	2.12
Calcium oxide,	56.28
Phosphoric acid,	1.21
Insoluble matter (before calcination),	15.11
Insoluble matter (after calcination),	12.63

5. Analyses, etc. — *Continued.*

Corn-cob Ashes.

	Per Cent.
Moisture at 100° C.,	1.20
Potassium oxide,	7.08
Calcium oxide,	11.70
Magnesium oxide,	—*
Ferric and aluminic oxides,	1.28
Phosphoric acid,	2.37
Insoluble matter (before calcination),	59.14
Insoluble matter (after calcination),	52.09

Ashes.

[Sent on from Cambridge, Mass.]

	Per Cent.
Moisture at 100° C.,	4.98
Potassium oxide,	10.64
Phosphoric acid,	6.96
Insoluble matter (before calcination),	23.16
Insoluble matter (after calcination),	20.01

Wool Waste.

[Sent on from North Andover, Mass.]

	Per Cent.
Moisture at 100° C.,	4.47
Potassium oxide,	1.32
Nitrogen,	2.27
Insoluble matter,	39.30

Horn Shavings.

[Sent on from Leominster, Mass.]

	Per Cent.
Moisture at 100° C.,	4.83
Ash,	0.67
Phosphoric acid,	0.42
Nitrogen,	15.31
Insoluble matter,	Trace.

* Not determined.

5. Analyses, etc. — *Continued.*

Tobacco Leaves.

[Sent on from Whately, Mass.]

	Per Cent.
Moisture at 100° C.,	13.05
Ash,	21.01
Potassium oxide,	7.24
Calcium oxide,	4.17
Magnesium oxide,	2.17
Ferric and aluminic oxides,	0.32
Phosphoric acid,	0.43
Nitrogen,	2.75
Insoluble matter,	4.17

I., Pine Needles; II., Pine Barren Grass.

[Sent on from Springfield, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	9.48	8.48
Ash,	3.42	2.40
Phosphoric acid,	0.12	0.18
Potassium oxide,	0.03	0.07
Nitrogen,	0.46	0.10
Insoluble matter,	1.22	1.07

Peat.

[Sent on from Weston, Mass.]

	Per Cent.
Moisture at 100° C.,	10.73
Ash,	17.26
Phosphoric acid,	0.03
Potassium oxide,	0.06
Nitrogen,	1.73
Insoluble matter,	10.14

Sludge.

[Sent on from Worcester, Mass.]

	Per Cent.
Moisture at 100° C.,	6.28
Ash,	70.05
Phosphoric acid,	1.36
Calcium oxide,	8.66
Ferric and aluminic oxides,	17.68
Nitrogen,	0.68
Insoluble matter,	38.03

5. Analyses, etc. — *Continued.*

Muck.

[I., surface layer, one and one-half to four and one-half feet deep; II., under layer, four to six feet below surface, sent on from West Bridgewater, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	76.18	87.78
Ash,	8.24	1.23
Phosphoric acid,	0.08	0.02
Calcium oxide,	0.38	0.14
Nitrogen,	0.43	0.18
Insoluble matter,	6.45	0.63

Soot.

[Sent on from East Walpole, Mass.]

	Per Cent.
Moisture at 100° C.,	8.00
Ash,	88.98
Potassium oxide,	0.56
Calcium oxide,	3.50
Magnesium oxide,	0.83
Ferric and aluminic oxides,	2.01
Phosphoric acid,	0.83
Insoluble matter (before calcination),	82.52
Insoluble matter (after calcination),	80.72

Drainage from Manure Heaps.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	93.25
Ash,	3.66
Phosphoric acid,	0.24
Potassium oxide,	0.88
Total nitrogen,	0.98
Nitrogen as ammonia,	0.65

5. Analyses, etc. — *Continued.*

Muriate of Potash.

[I., sent on from Amherst, Mass.; II. and III., sent on from South Hadley Falls, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	0.54	1.07	0.85
Potassium oxide,	51.44	49.60	50.24
Insoluble matter,	Trace.	Trace.	Trace.

Sulphate of Potash.

[Sent on from Hatfield, Mass.]

	Per Cent.
Moisture at 100° C.,	2.22
Potassium oxide,	47.00
Insoluble matter,	Trace.

Gypsum (Land Plaster).

[Sent on from Millington, Mass.]

	Per Cent.
Moisture at 100° C.,	14.01
Calcium oxide,	33.45
Sulphuric acid,	46.86
Carbonic acid,	Trace.
Insoluble matter,	0.63

Gypse (Calcium Carbonate).

[Sent on from Pittsfield, Mass.]

	Per Cent.
Moisture at 100° C.,	1.64
Calcium oxide,	50.87
Insoluble matter,	2.87

5. Analyses, etc. — *Continued.*

Florida Phosphates.

[I., II. and III., sent on from Concord, Mass.; IV., sent on from Marlborough, Mass.; V., sent on from Townsend, Mass.; VI., from station barn.]

	Per Cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	1.38	0.36	1.51	2.24	3.08	2.53
Ash,	94.99	96.20	91.93	86.63	–*	89.52
Phosphoric acid,	36.80	36.26	33.88	17.71	17.24	21.72
Calcium oxide,	46.21	51.78	45.53	14.64	25.62	17.89
Ferric and aluminic oxides,	8.38	5.62	9.80	6.72	11.00	14.25
Carbonic acid,	–*	–*	–*	–*	4.45	1.83
Insoluble matter,	1.42	2.20	1.47	13.37	29.22	30.50

Virginia Phosphatic Marls.

[I. and II., sent on from Arlington, Mass.; III., IV. and V., sent on from Enfield, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	1.30	1.10	1.25	1.97	3.30
Ash,	94.85	90.94	–*	–*	–*
Total phosphoric acid,	9.06	5.99	9.37	13.73	10.39
Soluble phosphoric acid,	0.26	0.08	0.00	0.00	0.00
Reverted phosphoric acid,	0.15	0.22	0.00	0.00	0.41
Insoluble phosphoric acid,	8.65	5.69	9.37	13.73	9.98
Potassium oxide,	–	–	1.14	0.24	Trace.
Calcium oxide,	20.47	19.74	25.78	19.16	–*
Ferric and aluminic oxides,	5.76	6.60	5.13	6.00	–*
Nitrogen,	–	–	–	–	1.61†
Insoluble matter,	59.56	54.95	41.32	50.55	–

* Not determined. † Addition, from an outside source.

5. Analyses, etc. — *Continued.*

Ground Bone.

[I., sent on from Northborough, Mass.; II. and III., sent on from Westborough, Mass.; IV., sent on from Townsend, Mass.]

Mechanical Analyses.

	Per Cent.			
	I.	II.	III.	IV.
Fine,	51.57	47.50	46.93	37.30
Fine medium,	36.59	23.96	24.76	20.01
Medium,	11.84	16.10	17.46	24.83
Coarse medium,	–	12.44	10.85	17.86

Chemical Analyses.

	I.	II.	III.	IV.
Moisture at 100° C.,	3.30	2.28	2.85	3.50
Ash,	57.56	62.86	65.61	72.43
Total phosphoric acid,	23.50	26.07	27.07	26.23
Soluble phosphoric acid,	0.26	0.31	0.26	0.14
Reverted phosphoric acid,	7.43	8.16	9.10	5.28
Insoluble phosphoric acid,	15.81	17.60	17.71	20.81
Nitrogen,	4.02	2.71	2.90	2.12
Insoluble matter,	1.14	Trace.	Trace.	0.30

Bone Dust.

[Sent on from Hatfield, Mass.]

	Per Cent.
Moisture at 100° C.,	9.70
Total phosphoric acid,	26.39
Soluble phosphoric acid,	0.15
Reverted phosphoric acid,	14.32
Insoluble phosphoric acid,	11.92
Nitrogen,	3.74
Insoluble matter,	Trace.

Ivory Dust.

[Sent on from Lincoln, Mass.]

	Per Cent.
Moisture at 100° C.,	11.50
Ash,	52.63
Total phosphoric acid,	24.56
Soluble phosphoric acid,	0.97
Reverted phosphoric acid,	17.97
Insoluble phosphoric acid,	5.62
Nitrogen,	6.64

5. Analyses, etc. — *Continued.*

Blood, Meat and Bone.

[Sent on from Holyoke, Mass.]

	Per Cent.
Moisture at 100° C.,	19.94
Ash,	19.76
Total phosphoric acid,	7.16
Soluble phosphoric acid,	0.51
Reverted phosphoric acid,	3.78
Insoluble phosphoric acid,	2.87
Nitrogen,	7.44
Insoluble matter,	0.52

Fish.

[I., sent on from Marshfield, Mass.; II., sent on from Danvers, Mass.; III., sent on from Marblehead, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	37.88	6.96	6.17
Ash,	33.68	19.69	33.75
Total phosphoric acid,	5.45	8.14	15.10
Soluble phosphoric acid,	Trace.	–*	–*
Reverted phosphoric acid,	1.09	–*	–*
Insoluble phosphoric acid,	4.36	–*	–*
Nitrogen,	5.13	8.70	7.16
Insoluble matter,	0.21	1.07	2.77

I., Rat Guano (Virginia); II. and III., Bat Guanos (Virginia).

[Sent on from Lake Weir, Fla.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	10.32	12.15	19.18
Ash,	–*	–*	68.40
Phosphoric acid,	2.30	3.26	3.44
Potassium oxide,	6.85	1.77	–
Nitrogen,	3.32	9.74	–
Insoluble matter,	1.15	5.77	32.89

* Not determined.

5. Analyses, etc. — *Concluded.*

Cotton-seed Meal.

[Sent on from Sunderland, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	4.35	5.83
Ash,	3.35	6.77
Phosphoric acid,	3.51	3.33
Potassium oxide,	2.25	2.01
Nitrogen,	6.86	6.66
Insoluble matter,	0.09	0.28

Home-mixed Fertilizers.

[I., sent on from Littleton, Mass.; II., sent on from Eastham, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	10.05	8.80
Ash,	62.74	78.24
Total phosphoric acid,	7.04	5.97
Soluble phosphoric acid,	5.77	5.21
Reverted phosphoric acid,	1.14	0.45
Insoluble phosphoric acid,	0.13	0.31
Potassium oxide,	18.56	18.08
Nitrogen,	3.38	4.68
Insoluble matter,	3.51	1.05

Complete Fertilizer.

[I., sent on from Norfolk, Mass.; II., sent on from Greenfield, Mass.; III. and IV.,* sent on from Eastham, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	8.61	6.90	9.92	8.35
Ash,	60.23	–†	–†	–†
Total phosphoric acid	9.98	8.32	9.34	20.60
Soluble phosphoric acid,	5.99	2.56	0.51	0.64
Reverted phosphoric acid,	3.45	3.46	3.71	8.19
Insoluble phosphoric acid,	0.54	2.30	5.12	11.77
Potassium oxide,	0.91	10.23	0.98	–
Nitrogen,	1.80	3.84	7.36	4.35
Insoluble matter,	7.67	–†	–†	–†

* Not a complete fertilizer, lacks potash. † Not determined.

6. Miscellaneous Analyses.

Exudation from an Elm Tree.

[Sent on from Greenfield, Mass.]

	Per Cent.
Moisture at 100° C.,	10.92
Glucose,	10.56
Sucrose,	72.62
Matter insoluble in water,	1.45
Resinous matter soluble in alcohol,	0.15

I., Skin or Husk Covering of the Coffee-cherry; II., Parchment Covering of the Coffee-bean.

[Sent on from Cambridge, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	9.69	8.57
Ash,	7.78	4.27
Phosphoric acid,	0.43	0.13
Potassium oxide,	1.55	0.97
Nitrogen,	1.27	0.78
Insoluble matter,	2.87	1.72

Baking Powder.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	15.20
Sodium oxide,	12.56
Calcium oxide,	6.60
Aluminium oxide,	3.31
Total carbonic acid,	12.40
Available carbonic acid,	11.65
Phosphoric acid,	12.49
Sulphuric acid,	15.98
Nitrogen,	1.13
Starch,	18.30
Insoluble matter,	0.73

6. Miscellaneous Analyses — *Concluded.*

Preservaline.

[Sent on from Brightwood, Mass.]

	Per Cent. I.	Per Cent. II.
Moisture at 100° C.,	5.56	3.96
Sodium oxide,	32.16	26.81
Potassium oxide,	0.80	15.79
Calcium oxide,	Trace.	Trace.
Chlorine,	21.79	23.09
Nitrogen,	0.26	4.90
Sulphuric acid,	1.04	1.43
Insoluble matter,	0.08	0.09

Cider.

[Sent on from North Amherst, Mass.]

	Per Cent.
Alcohol,	4.53
Acid calculated as acetic,	0.60
Solid residue,	1.79

Vinegar.

	Per Cent.
Specific gravity,	1.00939
Acetic acid,	6.18
Solid residue,	1.33

Damaged Oats.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	13.70
Dry matter,	86.30
	100.00

Analysis of Dry Matter.

Crude ash,	4.03
" cellulose,	12.44
" fat,	5.96
" protein,	12.59
Non-nitrogenous extract matter,	64.98
	100.00

II.

Analyses of Milk sent on for Examination.

[Per Cent.]

Number of Sample.	Solids.	Fat.	Solids not Fat.	Locality.	Remarks.
1, . .	15.23	6.92	8.31	North Adams.	
2, . .	7.79	0.41	7.38	Amherst.	Buttermilk.
3, . .	8.09	0.48	7.61	"	"
4, . .	8.48	0.36	8.12	"	"
5, . .	8.62	0.82	7.80	"	"
6, . .	8.78	0.27	8.51	"	"
7, . .	8.01	0.51	7.50	"	"
8, . .	13.25	4.25	9.00	Northborough.	
9, . .	15.38	6.00	9.38	Worcester.	
10, . .	11.72	3.69	8.03	Lancaster.	
11, . .	10.00	1.84	8.16	"	
12, . .	12.64	3.83	8.81	"	
13, . .	11.35	2.86	8.49	"	
14, . .	11.75	3.19	8.56	"	
15, . .	11.76	4.09	7.67	"	
16, . .	12.59	3.71	8.88	"	
17, . .	10.36	2.90	7.46	"	
18, . .	13.80	3.99	8.81	"	
19, . .	12.30	3.40	8.90	"	
20, . .	11.00	3.19	7.81	"	
21, . .	11.49	3.18	8.31	"	
22, . .	11.21	2.38	8.83	Chicopee.	
23, . .	11.74	3.62	8.12	Warren.	
24, . .	12.03	3.90	8.13	"	
25, . .	13.40	4.39	9.01	"	
26, . .	11.15	2.90	8.25	"	
27, . .	12.69	4.08	8.61	"	
28, . .	12.56	4.01	8.55	"	
29, . .	12.82	4.40	8.42	West Brookfield.	
30, . .	12.58	3.79	8.79	"	
31, . .	14.72	5.52	9.20	New Braintree.	
32, . .	14.36	5.02	9.34	"	
33, . .	15.07	5.65	9.42	"	
34, . .	16.50	7.17	9.33	"	
35, . .	13.73	4.78	8.95	"	
36, . .	13.92	4.86	9.06	"	
37, . .	13.90	5.06	8.84	"	
38, . .	13.21	4.36	8.85	"	
39, . .	14.63	5.34	9.29	"	

Analyses of Milk, etc. — *Concluded.*

Number of Sample.	Solids.	Fat.	Solids not Fat.	Locality.	Remarks.
40, . .	15.54	6.33	9.21	New Braintree.	
41, . .	12.83	4.17	8.66	"	
42, . .	13.31	4.61	8.70	"	
43, . .	12.28	3.25	9.03	Warren.	
44, . .	12.27	3.25	9.02	"	
45, . .	15.18	4.67	10.51	"	
46, . .	11.86	3.01	8.85	"	
47, . .	12.54	3.49	9.05	"	
48, . .	12.43	3.32	9.11	"	
49, . .	14.93	6.86	8.07	Furnace.	
50, . .	11.94	3.44	8.50	"	
51, . .	12.20	3.48	8.72	Old Furnace.	
52, . .	12.58	3.52	9.06	"	
53, . .	11.95	3.19	8.76	Furnace.	
54, . .	12.13	3.54	8.59	"	
55, . .	13.82	4.09	9.73	"	
56, . .	12.09	3.62	8.47	"	
57, . .	13.02	4.14	8.88	"	
58, . .	11.61	2.98	8.63	"	
59, . .	11.98	3.35	8.63	"	
60, . .	12.55	3.68	8.87	"	
61, . .	11.93	3.34	8.59	"	
62, . .	12.47	3.81	8.66	"	
63, . .	12.07	3.62	8.45	South Lancaster.	
64, . .	12.42	3.68	8.74	"	
65, . .	11.43	3.12	8.31	"	
66, . .	10.63	2.86	7.77	"	
67, . .	11.65	3.53	8.12	"	
68, . .	11.62	3.31	8.31	"	
69, . .	12.33	4.17	8.16	"	
70, . .	11.56	3.11	8.45	Chicopee.	
71, . .	11.51	3.76	7.75	"	
72, . .	11.86	3.76	8.10	"	
73, . .	13.35	4.71	8.64	North Amherst.	
74, . .	13.13	4.14	8.99	"	

Analysis of Milk sent on for Examination.

[Babcock Mode.]

Number of Sample.	Fat (Per Cent.).	Locality.	Number of Sample.	Fat (Per Cent.).	Locality.
1, . . .	6.30	Hadley.	21, . .	4.90	Amherst.
2, . . .	5.60	"	22, . .	3.70	"
3, . . .	5.25	"	23, . .	3.70	"
4, . . .	5.20	"	24, . .	3.80	"
5, . . .	4.25	"	25, . .	4.50	"
6, . . .	4.45	"	26, . .	3.30	"
7, . . .	5.40	"	27, . .	4.00	"
8, . . .	5.50	"	28, . .	4.10	"
9, . . .	5.50	"	29, . .	5.40	"
10, . . .	4.65	"	30, . .	3.30	"
11, . . .	4.40	"	31, . .	3.30	"
12, . . .	5.15	"	32, . .	3.60	"
13, . . .	5.80	"	33, . .	3.90	"
14, . . .	4.85	"	34, . .	3.40	"
15, . . .	5.60	"	35, . .	3.00	"
16, . . .	4.40	"	36, . .	3.00	"
17, . . .	5.25	"	37, . .	3.30	"
18, . . .	2.80	Amherst.	38, . .	2.90	"
19, . . .	3.00	"	39, . .	3.00	"
20, . . .	2.10	"			

III.

Analyses of Water sent on for Examination.*

[Parts per million.]

Number.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
1	.004	.100	4.00	116.00	40.00	0.48	None.	Amherst.
2	.990	.440	15.00	164.00	54.00	2.47	None.	Weston.
3	.080	.270	9.00	105.00	45.00	2.73	None.	Weston.
4	.260	.964	34.00	237.00	130.00	-	-	Grafton.
5	.010	.096	8.00	90.00	30.00	2.08	None.	North Amherst.
6	.006	.106	5.00	110.00	60.00	1.95	None.	Amherst.
7	.066	.248	33.00	236.00	86.00	2.21	-	Amherst.
8	.020	.340	66.00	294.00	84.00	4.43	None.	Medway.
9	.100	.298	13.00	172.00	60.00	-	-	Worcester.
10	.146	.352	70.00	434.00	112.00	8.86	None.	Cochituate.
11	.010	.170	2.00	72.00	22.00	0.95	None.	Amherst.
12	.024	.112	8.00	70.00	20.00	2 86	None.	Amherst.
13	.217	.248	85.00	640.00	381.00	11.05	None.	Weston.
14	.047	.107	20.00	84.00	22.00	1.43	None.	Billerica.
15	.051	.595	3.00	206.00	90.00	5.57	None.	Amherst.
16	.020	.088	4.00	50.00	26.00	0.00	None.	Weston.
17	.044	.069	8.00	130.00	82.00	1.69	None.	Weston.
18	.226	.362	12.00	192.00	62.00	1.27	-	Prescott.
19	.096	.256	30.00	248.00	108.00	5.29	-	North Hadley.
20	.108	.238	7.00	276.00	136.00	-	-	Amherst.
21	.052	.438	6.00	150.00	30.00	2.47	None.	Littleton.
22	.576	.444	7.00	140.00	48.00	2.99	None.	Littleton.
23	.030	.225	65.00	474.00	264.00	14.21	None.	Barre.
24	.249	.163	28.00	320.00	176.00	2.73	-	South Deerfield.
25	.394	.472	2.00	106.00	32.00	0.63	None.	South Amherst.
26	-	-	-	-	-	-	None.	Amherst.

* Analysis of well water at the station is confined to chemical tests with reference to an excess of foreign matter from sinks, barns, etc.

Analyses of Water, etc. — *Continued.*

Number.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat	Hardness (Clark's Degree).	Lead.	Locality.
27	.104	.128	24.00	128.00	64.00	2.99	None.	Concord.
28	.112	.180	64.00	440.00	168.00	6.00	None.	Concord.
29	.080	.128	22.00	232.00	96.00	2.73	None.	Concord.
30	.424	.612	44.00	496.00	216.00	5.14	None.	Concord.
31	.032	.068	9.00	114.00	80.00	3.12	None.	South Amherst.
32	.024	.096	5.00	44.00	17.00	-	-	Greenwich.
33	.078	.466	170.00	638.00	474.00	13.91	-	Orange.
34	.038	.114	10.00	60.00	28.00	1.68	None.	Weston.
35	.130	.164	44.00	154.00	50.00	0.76	None.	Montague.
36	.072	.228	6.00	124.00	52.00	2.21	-	Barre.
37	.070	.257	14.00	132.00	20.00	1.69	-	East Foxborough.
38	.016	.260	2.00	44.00	24.00	1.95	-	Shirley.
39	.008	.160	26.00	148.00	58.00	4.16	-	Shirley.
40	.020	.206	4.00	260.00	32.00	1.43	-	Shirley.
41	.012	.146	3.00	64.00	18.00	0.48	-	Shirley.
42	.061	.235	24.00	194.00	62.00	4.29	None.	Amherst.
43	.018	.128	5.00	90.00	48.00	1.11	None.	Barre.
44	.030	.077	9.00	122.00	46.00	0.92	None.	Boston.
45	.028	.248	20.00	210.00	60.00	3.25	-	Amherst.
46	.112	.370	5.00	50.00	6.00	0.00	None.	Concord.
47	.022	.344	4.00	54.00	10.00	0.16	None.	Concord.
48	.050	.260	4.00	52.00	10.00	1.27	None.	Concord.
49	.022	.254	5.00	54.00	10.00	0.00	None.	Concord.
50	.004	.090	3.00	30.00	10.00	1.95	None.	Hadley.
51	.005	.212	8.00	-	-	-	-	Hadley.
52	.036	.056	5.00	162.00	104.00	3.38	None.	Littleton.
53	.040	.130	20.00	208.00	78.00	4.03	None.	Littleton.
54	.072	.108	13.00	102.00	42.00	1.69	None.	Littleton.
55	.032	.232	24.00	204.00	80.00	4.43	None.	Littleton.
56	.024	.324	16.00	170.00	56.00	3.25	None.	Amherst.
57	.058	.085	9.00	86.00	18.00	1.43	-	East Foxborough.
58	.208	.132	20.00	196.00	66.00	4.86	None.	Amherst.
59	.240	.186	13.00	168.00	54.00	2.08	None.	Leverett.
60	.116	.096	36.00	280.00	34.00	3.38	None.	Amherst.

ANALYSES OF WATER, ETC. — *Continued.*

Number.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
61	.172	.552	11.00	150.00	30.00	1.95	None.	South Amherst.
62	.076	.170	44.00	294.00	124.00	5.86	-	Amherst.
63	.072	.193	13.00	226.00	112.00	2.73	None.	Northampton.
64	.342	.612	46.00	-	-	-	-	Amesbury.
65	.012	.126	50.00	142.00	60.00	1.43	-	Amesbury.
66	.007	.060	9.00	190.00	140.00	6.14	-	Springfield.
67	.014	.162	18.00	190.00	64.00	2.60	-	South Amherst.
68	.027	.090	10.00	190.00	60.00	3.25	None.	Agawam.
69	.036	.088	15.00	168.00	78.00	1.56	-	Amherst.
70	.012	.042	3.00	72.00	28.00	0.63	-	North Amherst.
71	.022	.039	8.00	96.00	60.00	0.95	-	Amherst.
72	.016	.116	6.00	68.00	12.00	0.00	-	Westminster.
73	.000	.076	34.00	184.00	76.00	3.51	-	Concord.
74	.048	.088	14.00	140.00	52.00	2.21	-	Concord.
75	.012	.096	8.00	188.00	84.00	1.27	-	Concord.
76	.016	.080	46.00	336.00	124.00	4.16	-	Concord.
77	.040	.140	6.00	104.00	52.00	0.32	-	Concord.
78	.024	.112	8.00	-	-	3.90	-	Chesterfield.
79	.100	.216	30.00	328.00	72.00	6.86	-	South Deerfield.
80	.016	.060	14.00	176.00	96.00	2.21	-	Medway.
81	1.340	.140	10.00	344.00	116 00	5.14	-	Smithville.
82	.036	.444	5.00	116.00	44.00	2.21	-	Ludlow.
83	.116	.212	4.00	180.00	104.00	2.08	-	Ludlow.
84	.144	.236	5.00	204.00	70.00	1.95	-	Ludlow.
85	.000	.064	20.00	248.00	80.00	3.25	-	Amherst.
86	.012	.048	6.00	114.00	60.00	0.16	-	Amherst.
87	.048	.128	3.00	-	-	4.57	-	Amherst.
88	.012	.048	18.00	160.00	64.00	2.73	-	South Deerfield.
89	.156	.100	32.00	348.00	116.00	6.71	-	South Deerfield.
90	.008	.176	12.00	196.00	68.00	0.63	-	Amherst.
91	.016	.088	14.00	172.00	100.00	3.51	-	Weston.
92	.176	.120	42.00	360.00	176.00	1.95	None.	Plainville.
93	.104	.076	24.00	-	-	7.29	None.	North Hadley.
94	.016	.084	4.00	244.00	132.00	2.34	-	North Amherst.

ANALYSES OF WATER, ETC. — *Concluded.*

Number.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
95	.000	.148	6.00	160.00	44.00	0.32	None.	Bolton.
96	.108	.056	8.00	168.00	92.00	2.47	None.	Weston.
97	.000	.072	4.00	136.00	64.00	0.32	None.	Rockville.
98	2.032	.168	42.00	324.00	164.00	8.86	-	North Hadley.
99	.088	.128	8.00	304.00	156.00	6.29	-	Amherst.
100	.280	.264	16.00	268.00	164.00	1.82	-	South Sudbury.
101	.008	.116	36.00	-	-	3.51	-	Amherst.
102	.048	.112	8.00	124.00	48.00	1.69	-	South Deerfield.
103	.112	.120	8.00	200.00	88.00	2.47	-	Westford.
104	.040	.076	6.00	172.00	64.00	3.25	-	Weston.
105	.012	.068	8.00	142.00	46.00	2.34	-	Waltham.
106	1.468	.368	26.00	548.00	312.00	8.00	-	North Andover.
107	.160	.272	108.00	472.00	148.00	8.71	-	North Andover.
108	.100	.128	10.00	180.00	68.00	3.25	-	North Andover.
109	.040	.128	15.00	100.00	28.00	3.38	-	Templeton.

The analyses have been made according to Wanklyn's process, familiar to chemists, and are directed towards the indication of the presence of chlorine, free and albuminoid ammonia, and the poisonous metals, lead in particular. (For a more detailed description of this method, see "Water Analyses," by J. A. Wancklyn and E. T. Chapman.)

Mr. Wancklyn's interpretation of the results of his mode of investigation is as follows: —

1. Chlorine alone does not necessarily indicate the presence of filthy water.

2. Free and albuminoid ammonia in water, without chlorine, indicates a vegetable source of contamination.

3. More than five grains per gallon * of chlorine (=71.4 parts per million), accompanied by more than .08 parts per million of free ammonia and more than .10 parts per million of albuminoid ammonia, is a clear indication that the water

* One gallon equals 70,000 grains.

is contaminated with sewage, decaying animal matter, urine, etc., and should be condemned.

4. Eight hundredth parts per million of free ammonia and one tenth part per million of albuminoid ammonia render a water very suspicious, even without much chlorine.

5. Albuminoid ammonia, over .15 parts per million, ought to absolutely condemn a water which contains it.

6. The total solids found in the water should not exceed forty grains per gallon (571.4 parts per million).

An examination of the previously stated analyses indicates that Nos. 2, 3, 4, 9, 10, 13, 18, 19, 20, 22, 24, 25, 27, 28, 29, 30, 35, 46, 58, 59, 60, 61, 64, 79, 81, 83, 84, 89, 92, 93, 96, 98, 99, 100, 103, 106, 107 and 108 ought to be condemned as unfit for family use; while Nos. 7, 8, 14, 15, 21, 23, 33, 36, 37, 42, 48, 53, 54, 62, 63, 82 and 109 must be considered suspicious. From this record it will be seen that over one-third of the entire number of well waters tried proved unfit for drinking. Heating waters to the boiling point not unfrequently removes immediate danger.

Parties sending on water for analysis should be very careful to use clean vessels, clean stoppers, etc. The samples should be sent on without delay after collecting. One gallon is desirable for the analysis.

IV. Compilation of Analyses made at Amherst, Mass., of Agricultural Chemicals and Refuse Materials used for Fertilizing Purposes.

Prepared by C. S. Crocker.

[As the basis of valuation changes from year to year, no valuation is stated.]

1868-1893.

This compilation does not include the analyses made of licensed fertilizers. They are to be found in the reports of the State Inspector of Fertilizers from 1873 to 1892, contained in the reports of the Secretary of the Massachusetts State Board of Agriculture for those years.

C. A. G.

	Analyses.	Moisture.	Ash.	Nitrogen. Maximum.	Nitrogen. Minimum.	Nitrogen. Average.	Potash. Maximum.	Potash. Minimum.	Potash. Average.	Total Phosphoric Acid. Maximum.	Total Phosphoric Acid. Minimum.	Total Phosphoric Acid. Average.	Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
I. Chemicals, Refuse, Salts, Ashes, etc.																							
Muriate of potash,	61	1.95	-	-	-	-	58.98	45.94	**51.37**	-	-	-	-	-	-	6.69	-	.55	-	-	-	48.80	.70
Sulphate of potash,	22	2.71	-	-	-	-	51.28	21.36	**33.65**	-	-	-	-	-	-	4.46	-	1.50	-	45.72	-	-	.75
Sulphate of potash and magnesia,	15	4.75	-	-	-	-	29.48	16.96	**23.50**	-	-	-	-	-	-	6.25	2.57	-	-	44.25	-	2.60	1.41
Kainite,	4	3.20	-	-	-	-	16.48	12.51	**13.54**	-	-	-	-	-	-	18.97	1.15	9.80	-	20.25	-	33.25	2.13
Carnallite,	1	-	-	-	-	-	-	-	**13.68**	-	-	-	-	-	-	7.66	-	13.19	-	.56	-	41.56	-
Krugite,	1	4.82	-	-	-	-	-	-	**8.42**	-	-	-	-	-	-	5.27	12.45	8.79	-	31.94	-	6.63	14.96
Sulphate of magnesia (Kieserite),	9	22.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.82	17.30	-	36.10	-	-	5.73
Nitrate of potash,	2	1.93	-	14.58	11.60	**13.09**	45.62	44.76	**45.19**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate of soda,	22	1.40	-	16.01	14.44	**15.70**	-	-	-	-	-	-	-	-	-	35.50	-	-	-	-	-	.50	.50
Sulphate of ammonia,	24	1.00	-	21.68	19.70	**20.50**	-	-	-	-	-	-	-	-	-	-	-	-	-	60.00	-	-	-
Saltpetre waste,	11	2.60	-	3.30	.52	**2.28**	30.94	1.55	**14.34**	-	-	-	-	-	-	36.50	.75	.19	-	1.85	-	48.30	-
Nitre salt-cake,	2	6.03	-	-	-	**2.29**	-	-	**.87**	-	-	-	-	-	-	29.56	-	-	-	47.77	-	-	3.92
Wood ashes,	231	12.36	-	-	-	-	10.80	2.32	**5.21**	5.58	.51	**1.70**	-	-	-	-	33.88	3.31	.96	-	-	-	13.98
Cotton-seed-hull ashes,	36	7.49	-	-	-	-	42.12	9.91	**22.41**	13.67	2.89	**8.43**	-	-	-	-	9.33	10.47	1.71	-	-	-	13.51
Ashes of spent tan-bark,	5	4.84	-	-	-	-	2.87	.60	**1.81**	2.77	.13	**1.36**	-	-	-	-	31.11	3.39	1.78	-	-	-	25.21
Corn-cob ashes,	1	1.20	-	-	-	-	-	-	**7.08**	-	-	**2.37**	-	-	-	-	11.70	-	1.28	-	-	-	52.09

Railroad tie ashes,	1	4.70	-	-	-	-	-	-	.92	-	-	.56	-	-	-	-	2.51	-	-	-	-	-	80.20
Peat ashes,	1	4.67	-	-	-	-	-	-	.46	-	-	.11	-	-	-	-	2.28	1.63	6.13	-	-	-	45.17
Logwood ashes,	1	1.50	-	-	-	-	-	-	.08	-	-	2.30	-	-	-	-	3.90	-	-	-	-	-	9.70
Hard-pine wood ashes,	1	.75	-	-	-	-	-	-	10.16	-	-	2.24	-	-	-	-	24.95	-	-	-	-	-	29.90
Mill ashes,	1	.53	-	-	-	-	-	-	1.60	-	-	.46	-	-	-	-	34.93	1.35	-	-	-	-	36.36
Ashes from blue works,	1	12.14	63.78	-	-	-	-	-	9.02	-	-	-	-	-	-	-	-	-	-	-	-	-	12.30
Sea-weed ashes,	1	1.47	-	-	-	-	-	-	.92	-	-	.30	-	-	-	8.76	6.06	4.37	-	2.98	-	6.60	63.65
Gypsum,	2	13.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32.09	-	-	47.41	-	-	.59
Gypse,	1	1.64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50.87	-	-	-	-	-	2.87
Nova Scotia plaster,	10	6.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33.85	.75	-	45.75	-	-	2.50
Onondaga plaster,	4	13.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30.00	1.66	-	32.50	8.20	-	9.83
Gas-house lime,	3	22.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43.66	8.30	-	20.73	-	-	6.05
Lime waste from sugar factory,	1	36.30	-	-	-	-	-	-	.22	-	-	2.25	-	-	-	-	27.51	-	-	-	-	-	.32
Lime kiln ashes,	8	15.45	-	-	-	-	2.12	.02	1.02	3.16	.36	1.18	-	-	-	-	46.23	2.60	-	-	17.75	-	8.79
Marls (Massachusetts),	7	13.70	-	-	-	-	-	-	.24	2.72	.06	1.05	-	-	-	-	40.50	.64	.69	-	28.57	-	3.44
Marls (Virginia),	2	15.98	-	-	-	-	.61	.37	.49	.09	.08	.09	-	-	-	-	7.25	.21	-	.66	7.25	-	64.23
Green sand marl (Virginia),	1	1.25	-	-	-	-	-	-	1.14	-	-	9.37	-	-	-	-	25.78	-	5.13	-	-	-	41.32
Olive earth (Virginia),	1	1.97	-	-	-	-	-	-	.24	-	-	13.73	-	-	-	-	19.16	-	6.00	-	-	-	50.55
Ammoniated marl,	1	3.31	-	-	-	1.61	-	-	-	-	-	10.39	-	.41	9.98	-	-	-	-	-	-	-	-
Marl (North Carolina),	1	1.50	-	-	-	-	-	-	.04	-	-	.56	-	-	-	-	21.95	.61	-	-	-	-	50.18

	Analyses.	Moisture.	Ash.	Nitrogen.			Potash.			Total Phosphoric Acid.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
II. Guanos, Phosphates, etc.																							
Peruvian guano,	26	14.81	37.61	13.50	4.44	7.85	4.08	1.14	2.61	20.60	5.96	15.26	4.57	3.79	6.90	-	-	-	-	-	-	-	6.60
Bat guano from Texas,	9	40.09	18.24	10.51	2.58	6.47	-	-	1.31	6.53	1.00	3.76	-	-	-	-	-	-	-	-	-	-	2.00
Bat guano from Florida,	2	15.66	-	-	-	9.74	-	-	1.77	3.44	3.26	3.35	-	-	-	-	-	-	-	-	-	-	19.33
Rat guano from Florida,	1	10.32	-	-	3.32	-	-	-	6.85	-	-	2.30	-	-	-	-	-	-	-	-	-	-	1.15
Cuba guano,	5	24.27	-	2.74	.63	1.67	-	-	-	16.16	11.54	13.35	-	-	-	-	-	-	-	-	-	-	3.17
Caribbean guano (orchilla),	12	7.31	-	-	-	-	-	-	-	35.43	18.11	26.77	-	-	-	-	39.95	3.29	-	2.68	-	-	1.27
Mona Island guano,	1	13.32	-	-	-	.76	-	-	-	-	-	21.88	-	7.55	14.33	-	37.49	-	-	-	-	-	2.45
South Carolina rock phosphate,	5	1.50	-	-	-	-	-	-	-	30.51	25.81	28.03	.27	.07	27.69	-	41.87	3.03	4.80	-	-	-	9.04
Florida rock phosphate,	26	2.12	-	-	-	-	-	-	-	38.97	6.95	26.90	-	-	-	-	30.32	-	7.59	-	-	-	27.33
Soft Florida phosphate,	1	2.24	-	-	-	-	-	-	-	-	-	17.71	-	-	-	-	14.64	-	6.72	-	-	-	13.37
Navassa phosphate,	2	7.60	-	-	-	-	-	-	-	34.45	34.09	34.27	-	-	-	-	37.45	-	10.27	-	-	-	2 70
Brockville phosphate,	1	2.50	-	-	-	-	-	-	-	-	-	35.21	-	-	-	-	-	-	-	-	-	-	6.46
Phosphatic slag,	4	1.45	-	-	-	-	-	-	-	30.51	18.91	23 49	-	3.06	21.65	-	48.66	3.42	10.12	-	-	-	9.40
Dissolved bone-black,	2	7.50	47.50	-	-	-	-	-	-	17.54	15.35	16.45	15.60	.60	.19	-	-	-	-	-	-	-	1.50
Bone-black,	5	4.60	-	-	-	-	-	-	-	30.54	16.56	28.28	-	-	-	-	-	-	-	-	-	-	3.64
South American bone-ash,	1	7.00	-	-	-	-	-	-	-	-	-	35.89	-	-	-	-	44.89	-	-	-	-	-	4.50
Acid phosphate,	1	14.23	69.95	-	-	-	-	-	-	-	-	14.84	10.34	2 42	1.88	-	-	-	-	-	-	-	10.81

III. Refuse Substances.																							
Dried blood,	14	12.50	6.37	13.55	8.10	10.52	-	-	-	6.23	1.53	1.91	-	-	-	-	-	-	-	-	-	-	-
Ammonite	1	5.88	-	-	-	11.33	-	-	-	-	-	3.43	-	-	-	-	-	-	-	-	-	-	1.38
Oleomargarine refuse,	1	8.54	14.42	-	-	12.12	-	-	-	-	-	.88	-	-	-	-	-	-	-	-	-	-	.96
Felt refuse,	1	29.24	33.53	-	-	5.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sponge refuse,	1	7.25	-	-	-	2.43	-	-	-	-	-	3.19	-	-	-	-	3.94	1.27	-	-	-	-	39.05
Horn shavings,	1	4.83	-	-	-	15.31	-	-	-	-	-	.42	-	-	-	-	-	-	-	-	-	-	-
Ivory dust,	1	11.50	52.63	-	-	6.64	-	-	-	-	-	24.56	.97	17.97	5.62	-	-	-	-	-	-	-	-
Horn and hoof waste,	3	10.17	7.63	15.49	11.84	13.25	-	-	-	2.30	1.36	1.83	-	-	-	-	-	-	-	-	-	-	.24
Raw wool,	1	6.95	7.54	-	-	12.88	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.63
Wool waste,	8	14.26	24.10	10.20	1.05	5.27	3.08	.06	1.21	.67	.05	.35	-	-	-	-	.11	.06	.80	-	-	-	8.20
Wool washings (water),	1	-	-	-	-	-	-	-	3.92	-	-	-	-	-	-	.49	.28	-	-	-	-	-	-
Wool washings (acid),	1	-	-	-	-	-	-	-	4.20	-	-	-	-	-	-	.40	.61	.20	-	-	-	-	-
Wool washings (alkaline),	1	92.03	3.28	-	-	.09	-	-	1.09	-	-	-	-	-	-	.92	.04	-	-	-	-	-	.22
Meat mass,	5	12.09	13.60	11.50	9.69	10.44	-	-	-	3.58	.56	2.07	-	-	-	-	-	-	-	-	-	-	.58
Bone soup,	1	82.92	7.07	-	-	1.14	-	-	-	-	-	1.26	-	-	-	-	-	-	-	-	-	-	-
Dried soup from meat and bone,	1	14.80	8.40	-	-	9.97	-	-	-	-	-	.53	-	-	-	-	-	-	-	-	-	-	.64
Dried soup from rendering cattle feet,	1	10.80	7.50	-	-	14.47	-	-	-	-	-	.46	-	-	-	-	-	-	-	-	-	-	.26
Dried soup from horse rendering,	1	92.14	-	-	-	1.12	-	-	-	-	-	.14	-	-	-	-	-	-	-	-	-	-	-
Soap-grease refuse,	2	29.25	51.39	4.20	2.21	3.21	-	-	-	15.37	11.04	13.21	-	-	-	-	-	-	-	-	-	-	1.29
Bones,	139	7.39	56.03	4.70	1.62	4.01	-	-	-	32.52	15.16	23.34	.39	7.92	15.28	-	-	-	-	-	-	-	1.09
Tankage,	17	12.93	29.77	8.07	4.16	6.69	-	-	-	18.86	7.39	11.00	.31	5.02	5.67	-	-	-	-	-	-	-	1.27
Fish with less than twenty per cent. water,	60	12.63	21.50	11.40	6.81	7.24	-	-	-	11.26	5.50	8.24	.55	2.60	5.10	-	-	-	-	-	-	-	2.01

	Analyses.	Moisture.	Ash.	Nitrogen.			Potash.			Total Phosphoric Acid.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
III. Refuse Substances — Concluded.																							
Fish with between twenty and forty per cent water.	10	30.19	20.59	7.41	4.22	5.97	-	-	-	8.32	4.68	7 09	.74	2.69	3.64	-	-	-	-	-	-	-	1.68
Fish with more than forty per cent. water,	10	45.46	15.50	7.60	2.43	4.97	-	-	-	8.56	2.94	5.08	1.17	1.33	2.58	-	-	-	-	-	-	-	1.35
Whale meat, raw, ...	1	44.50	1.04	-	-	4.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lobster shells, ...	1	7.27	-	-	-	4.50	-	-	-	-	-	3.52	-	-	-	-	22.24	1.30	-	-	-	-	.27
Castor-bean pomace, ...	4	9.98	5.70	5.72	5.33	5.56	1.70	.64	1.12	2.22	1.57	2.16	-	-	-	-	.87	.29	-	-	-	-	1.75
Cotton-seed meal, ...	18	5.74	5.78	7.26	4.02	6.64	2.09	.89	1.72	3.36	1.26	1.82	-	-	-	-	.39	.99	-	-	-	-	.40
Rotten brewers' grain, ...	1	78.77	-	-	-	.72	-	-	.04	-	-	.43	-	-	-	-	.26	.15	-	-	-	-	.59
Tobacco leaf, ...	1	13.05	21.01	-	-	2.75	-	-	7.24	-	-	.43	-	-	-	-	4.17	2.17	.32	-	-	-	4.17
Tobacco stems, ...	6	10.61	14.07	2.91	.90	2.29	8.82	3.76	6.44	2.09	.44	.60	-	-	-	.34	3.89	1.23	-	-	-	-	.82
Cotton waste, wet, ...	1	34.69	-	-	-	1.30	-	-	.80	-	-	1.54	-	-	-	-	2.45	1.13	-	-	-	-	41.33
Cotton waste, dry, ...	3	6.44	60.60	2.09	.96	1.50	1.62	.66	1.10	.84	.26	.52	-	-	-	-	-	-	-	-	-	-	45.00
Cotton dust, ...	1	34.46	50.93	-	-	.50	-	-	.19	-	-	.21	-	-	-	-	.90	.90	-	-	-	-	47.46
Glucose refuse, ...	1	8.10	-	-	-	2.62	-	-	.15	-	-	.29	-	-	-	-	.18	.02	-	-	-	-	.07
Waste from lactate factory, ...	1	34.11	-	-	-	.68	-	-	-	-	-	.67	-	-	-	-	22.59	-	-	-	-	-	6.92
Hop refuse, ...	1	8.98	-	-	-	.98	-	-	.11	-	-	.20	-	-	-	-	.27	.10	-	-	-	-	.63
Banana skins, ...	1	13.99	-	-	-	.24	-	-	5.46	-	-	1.80	-	-	-	-	-	-	-	-	-	-	-
Sumac waste, ...	1	63.06	6.80	-	-	1.19	-	-	3.25	-	-	-	-	-	-	-	1.14	3.25	-	-	-	-	2.25
Eel-grass, ...	2	35.39	15.60	.96	.70	.83	1.61	.21	.91	.41	.22	.32	-	-	-	1.63	2.13	.11	-	-	-	-	1.06

Pine barren grass,	1	8.48	2.40	-	-	.16	-	-	.07	-	-	.18	-	-	-	-	-	-	-	-	-	-	1.67
Pine needles,	1	9.48	3.42	-	-	.46	-	-	.03	-	-	.12	-	-	-	-	-	-	-	-	-	-	1.22
Rockweed, green,	1	68.50	23.70	-	-	.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rockweed, dry,	1	10.68	35.75	-	-	1.45	-	-	4.89	-	-	2.75	-	-	-	7.90	7.66	.21	-	-	-	-	10.40
Jute waste,	1	13.10	-	-	-	1.50	-	-	.08	-	-	.72	-	-	-	-	-	-	-	-	-	-	-
Starch waste from rubber factory,	1	10.01	.23	-	-	.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sludge from sewage precipitating tanks,	1	88.49	9.50	-	-	.05	-	-	.05	-	-	.10	-	-	-	-	1.58	.39	6.22	-	-	-	.93
Sludge,	1	6.28	-	-	-	.68	-	-	-	-	-	1 36	-	-	-	-	8.66	-	17.68	-	-	-	38.03
Blue-green algæ (*Lyngbia majuscula*), dry,	1	16.26	-	-	-	4.25	-	-	.79	-	-	.19	-	-	-	3.53	2.06	1.18	-	-	-	-	5.53
Mussel mud, wet,	1	60.01	27.29	-	-	.21	-	-	6.17	-	-	.10	-	-	-	.70	.93	.14	3.48	-	-	-	-
Mussel mud, dry,	1	2.24	72.02	-	-	.72	-	-	-	-	-	.35	-	-	-	-	23.39	-	8.26	-	-	-	37.60
Salt mud,	2	53.37	41.19	.40	.39	.40	.33	.32	.33	-	-	-	-	-	-	.94	.91	.37	4.13	-	-	-	34.88
Fresh-water mud,	1	40.37	-	-	-	1.37	-	-	.22	-	-	.26	-	-	-	-	1.27	.29	1.80	-	-	-	18.26
Muck,	14	57.50	13.75	2.54	.26	1.05	-	-	-	.17	.08	.13	-	-	-	-	-	-	-	-	-	-	11.35
Peat,	10	61.50	8.20	1.40	.41	.85	-	-	.18	-	-	.08	-	-	-	-	.52	.72	2.14	-	-	-	2.20
Peat,	1	10.73	17.26	-	-	1.73	-	-	.06	-	-	.03	-	-	-	-	-	-	-	-	-	-	10.14
Turf,	2	19.29	6.36	1.97	1.91	1.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soot,	1	5.54	77.10	-	-	-	-	-	1.83	-	-	-	-	-	-	-	-	-	-	-	-	-	35.34
IV. Animal Excrement, etc.																							
Barn-yard manure,	34	69.49	-	.87	.21	.49	.85	.13	.45	.75	.10	.33	-	-	-	-	.30	.19	-	-	-	-	6.20
Drainage from a manure heap,	1	93.20	3.66	-	-	.98	-	-	.88	-	-	.24	-	-	-	-	-	-	-	-	-	-	-
Poudrette, dry,	1	5.25	35.45	-	-	3.58	-	-	.49	-	-	5.74	-	-	-	-	-	-	-	-	-	-	4.65
Hen manure, fresh,	2	52.35	24.75	1.20	.79	.99	.32	.18	.25	1.00	.47	.74	-	-	-	-	1.19	.89	-	1.24	-	-	23.50
Hen manure, dry,	1	8.35	-	-	-	2.13	-	-	9.94	-	-	2.02	-	-	-	-	2.22	.62	-	-	-	-	34.64

V. Compilation of Analyses of Fodder Articles, Fruits, Sugar-producing Plants, Dairy Products, etc.,

made at

AMHERST, MASS.

1868-1893.

Prepared by C. S. Crocker.

A. Analyses of Fodder Articles.

B. Analyses of Fodder Articles with Reference to Fertilizing Ingredients.

C. Analyses of Fruit.

D. Analyses of Sugar-producing Plants.

E. Dairy Products.

F. Insecticides.

A. *Analyses of Fodder Articles.*

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain— Protein.			Fat.			Nitrogen-free Extract.			Fibre.			Ash.	Nutritive Ratio (Average).
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
I. Green Fodders.																		
Fodder corn,	25	30.53	10.33	19.36	17.19	7.62	10.24	6.10	1.42	2.44	63.13	42.02	55.51	31.53	19.26	25.90	5.91	1:9.93
Fodder corn ensilage,	32	37.43	13.12	21.97	12.58	5.98	8.48	6.49	1.82	3.92	65.69	42.99	54.79	38.92	17.67	27.49	5.37	1:10.48
Corn and soja bean ensilage,	1	-	-	28.97	-	-	15.27	-	-	5.35	-	-	40.50	-	-	37.84	11.04	1:5.32
Sorghum,	6	23.18	12.38	17.41	11.84	7.46	8.74	2.00	1.21	1.55	64.93	47.65	56.15	29.27	22.00	26.73	6.83	1:11.85
Common millet,	9	49.29	21.32	35.42	12.16	5.43	7.50	3.99	2.09	2.74	58.61	46.39	53.89	33.98	24.88	30.99	4.84	-
Japanese millet (white head),	3	26.24	20.95	24.76	10.98	7.26	8.72	2.64	1.94	2.33	50.87	46.71	49.60	38.90	30.12	34.47	4.88	-
Japanese millet (red head),	6	33.83	22.66	27.33	7.99	4.92	6.90	2.45	1.58	2.01	60.83	50.11	52.91	35.29	25.21	32.10	6.08	-
White kibi,	2	24.26	22.85	23.56	15.14	10.79	12.97	1.61	1.50	1.56	53.66	52.30	52.91	31.70	23.03	27.37	5.19	-
Mochi millet,	3	42.29	30.07	37.42	11.90	6.11	9.94	1.94	1.74	1.81	67.08	49.06	55.69	29.80	20.01	25.56	7.00	-
Mix,	3	31.36	18.17	24.45	16.70	9.81	13.53	2.48	1.35	1.86	52.30	47.75	51.27	27.44	26.82	27.06	6.28	-
Green oats,	6	55.69	15.51	25.97	20.47	7.05	13.91	3.95	2.02	2.89	50.69	40.42	44.91	33.12	25.20	30.04	8.25	-
Green rye,	1	-	-	37.89	-	-	5.38	-	-	2.46	-	-	65.37	-	-	21.52	5.27	-
Green barley,	1	-	-	20.89	-	-	13.16	-	-	2.91	-	-	42.04	-	-	32.72	8.73	-
Timothy (*Phleum pratense* L.),	2	35.00	34.26	34.63	8.83	8.20	8.52	2.07	1.95	2.01	51.33	51.23	51.27	33.23	32.50	32.87	5.33	1:12.26
Hungarian grass (*Setaria Italica* Beauv.),	2	25.93	25.69	25.81	9.39	9.38	9.38	2.43	1.01	1.72	57.80	48.01	52.92	31.23	24.66	27.94	8.04	-
Vetch and oats (one part vetch and nine parts oats),	3	24.04	13.89	18.97	10.76	8.83	10.06	2.74	2.29	2.53	49.85	40.10	44.75	35.81	30.77	33.59	9.07	1:7.06

Vetch and oats (equal parts of each),	1	-	-	17.98	-	-	16.77	-	-	2.79	-	-	41.33	-	-	29.80	9.31	1:4.46
Barley and peas,	1	-	-	16.09	-	-	13.40	-	-	3.00	-	-	41.79	-	-	33.49	8.32	-
Oats and peas,	2	18.41	13.68	16.04	16.01	14.17	15.09	3.40	2.29	2.84	48.14	40.56	44.36	32.20	26.66	29.43	8.28	-
Horse bean, whole plant (*Vicia faba* L.),	1	-	-	15.17	-	-	16.68	-	-	2.31	-	-	47.09	-	-	28.17	5.75	1:2.71
Soja bean, whole plant (*Soja hispida* Mönch),	10	36.36	18.54	23.58	22.19	13.71	16.45	8.98	2.71	4.84	47.89	40.80	44.50	31.89	21.67	26.47	7.74	1:4.20
Cow-pea vines (*Dolichos sinensis* L.),	3	21.19	18.15	19.63	17.93	11.24	14.59	2.99	1.81	2.48	60.62	46.13	52.42	25.88	21.87	23.59	6.92	1:5.82
Serradella (*Ornithopus sativus* Brot.),	3	19.42	15.40	17.59	17.75	12.17	15.01	2.65	2.09	2.41	46.41	35.45	41.13	38.76	26.21	30.08	10.99	1:3.09
White lupine (*Lupinus albus* L.),	1	-	-	14.65	-	-	18.71	-	-	2.41	-	-	42.67	-	-	31.18	5.03	-
Spanish moss (*Tillandsia usneoides* L.),	1	-	-	39.20	-	-	4.45	-	-	2.54	-	-	57.73	-	-	32.61	2.67	-
II. Hay and Dry Coarse Fodders.																		
English hay (mixed hays),	11	91.94	86.96	89.85	11.93	8.47	9.67	3.18	1.56	2.38	54.72	44.95	49.59	35.55	29.21	32.15	6.21	1:9.55
Rowen of mixed hays,	13	91.16	75.55	82.38	14.70	11.63	12.64	5.03	2.60	3.60	53.52	41.92	49.89	31.50	24.25	26.63	7.24	1:6.76
Timothy hay,	6	92.76	81.26	89.39	9.37	7.24	8.66	2.65	1.95	2.22	54.43	50.01	51.55	36.59	29.21	32.90	4.88	1:11.94
Red-top hay (*Agrostis vulgaris* With.),	4	93.19	91.76	92.30	8.40	6.41	7.88	1.69	1.50	1.60	54.74	50.32	52.63	34.11	31.12	32.92	4.97	1:12.06
Kentucky blue-grass (*Poa pratensis* L.),	2	96.10	93.22	94.66	8.78	8.65	8.72	2.08	2.03	2.06	49.61	44.11	46.29	36.84	32.21	34.58	8.35	1:10.38
Orchard grass (*Dactylis glomerata* L.),	4	91.62	90.86	91.17	11.29	7.57	8.99	3.56	2.40	2.91	47.34	43.50	46.15	35.79	34.12	34.89	7.05	1:10.47
Meadow fescue (*Festuca pratensis* Huds.),	5	94.70	87.84	91.09	7.85	5.89	6.76	2.17	1.65	1.87	49.18	42.03	46.31	39.90	34.61	36.93	8.13	1:13.69
Perennial rye-grass (*Lolium perenne* L.),	4	93.64	90.50	92.60	16.56	6.59	11.71	3.15	1.59	2.37	55.77	38.82	48.14	30.86	26.79	29.64	8.14	1:7.40
Italian rye-grass (*Lolium Italicum* A. Br.),	4	92.62	90.70	91.54	9.75	6.20	8.15	2.07	1.39	1.85	52.80	43.09	49.14	36.90	31.27	33.34	7.52	1:10.90
Hungarian grass,	1	-	-	92.55	-	-	9.45	-	-	2.22	-	-	50.64	-	-	31.96	5.73	1:6.22
Barn-yard grass (*Panicum crus-galli* L.),	1	-	-	93.35	-	-	15.27	-	-	1.95	-	-	30.24	-	-	33.72	10.02	1:2.94
Hay of black-grass,	1	-	-	91.25	-	-	6.72	-	-	3.37	-	-	49.47	-	-	31.41	9.03	-

A. *Analyses of Fodder Articles* — Continued.

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain — Protein.			Fat.			Nitrogen-free Extract.			Fibre.			Ash.	Nutritive Ratio (Average)
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
II. Hay and Dry Coarse Fodders — Continued.																		
Low meadow hay,	1	-	-	91.99	-	-	9.51	-	-	1.88	-	-	46.27	-	-	35.59	6.75	-
Salt hay,	2	91.92	90.34	91.13	4.35	3.77	4.06	3.24	2.65	2.95	60.15	60.14	60.15	27.84	27.82	27.83	5.02	-
Millet,	6	93.85	90.25	92.54	8.88	7.09	7.81	3.63	.89	2.05	55.80	49.62	51.74	35.91	29.80	33.32	5.08	1:7.78
Oats in bloom,	1	-	-	93.57	-	-	6.58	-	-	2.92	-	-	50.03	-	-	34.06	6.41	1:14.23
Oats in milk,	1	-	-	90.45	-	-	10.89	-	-	2.69	-	-	46.02	-	-	34.32	6.08	1:7.90
Oats, ripe,	1	-	-	91.30	-	-	6.05	-	-	2.61	-	-	48.92	-	-	36.31	6.11	1:15.03
Winter rye in bloom,	1	-	-	91.45	-	-	10.66	-	-	2.57	-	-	47.40	-	-	32.97	6.40	1:8.28
Barley in milk,	1	-	-	89.75	-	-	10.26	-	-	2.76	-	-	52.91	-	-	29.12	4.95	1:9.59
Japanese buckwheat,	1	-	-	94.29	-	-	10.80	-	-	2.22	-	-	38.60	-	-	36.02	12.36	-
Dry fodder corn,	4	93.35	90.58	92.11	9.31	6.17	7.74	2.76	1.11	1.84	58.89	53.86	55.97	33.75	23.03	29.31	5.14	1:10.98
Corn stover,	26	94.44	75.00	88.18	12.15	5.46	7.29	2.63	1.08	1.38	63.05	44.65	50.82	38.83	20.93	34.84	5.67	1:11.62
Teosinte (*Euchlæna luxurians* Dur. and Asch.),	1	-	-	93.94	-	-	9.71	-	-	1.28	-	-	53.18	-	-	28.88	6.95	-
Mammoth red clover (*Trifolium medium* L.),	3	92.66	82.47	88.59	18.50	14.06	15.75	2.25	1.86	2.13	48.98	46.51	44.77	33.72	20.16	27.51	9.84	1:5.10
Medium red clover (*Trifolium pratense* L.),	2	94.90	93.98	94.44	15.01	14.63	14.82	2.62	2.36	2.49	43.88	42.81	43.34	30.76	29.97	30.37	8.98	1:5.52
Alsike clover (*Trifolium hybridum* L.),	6	93.92	86.48	90.07	17.55	14.77	16.63	3.26	1.88	2.58	46.64	38.03	42.72	32.34	21.44	26.17	11.90	1:3.25
Lucerne (alfalfa) (*Medicago sativa* Desr.),	5	95.40	84.00	91.40	16.34	11.12	14.22	2.50	1.04	1.65	51.62	40.25	46.20	34.39	25.42	29.72	8.11	1:4.09

Sand lucerne (*Medicago media* Pers.),	1	–	–	91.20	–	–	16.26	–	–	2.59	–	–	50.31	–	–	21.27	9.57	1:3.50
Bokhara clover (*Melilotus alba* Desr.),	2	93.64	91.50	92.57	14.93	11.81	13.37	4.79	1.85	3.32	51.36	38.83	45.08	33.05	28.08	30.57	7.66	–
Blue melilot (*Melilotus cærulea* Desr.),	1	–	–	91.78	–	–	13.81	–	–	1.67	–	–	43.22	–	–	27.17	14.87	–
Sainfoin (*Onobrychis sativa*),	1	–	–	87.83	–	–	17.70	–	–	4.49	–	–	42.27	–	–	26.95	8.54	–
Sulla (*Hedysarum coronarium*),	2	91.68	89.59	90.61	17.03	16.90	16.97	3.16	2.39	2.78	58.66	41.89	50.26	28.95	12.38	20.67	9.32	–
Hairy lotus (*Lotus villosus* Thuill),	2	89.32	87.64	88.48	16.12	13.49	14.81	3.00	2.69	2.85	57.82	50.80	54.29	24.48	15.07	19.78	8.27	–
Soja bean,	3	93.88	79.91	89.10	19.06	15.10	16.68	8.33	5.62	6.77	51.28	41.09	46.96	25.84	20.76	22.79	6.90	1:4.23
Cow-pea,	3	90.70	90.25	90.43	17.17	16.95	17.05	4.49	3.81	4.06	51.41	46.06	47.93	23.58	19.06	21.67	9.29	1:4.82
Small pea (*Lathyrus sativus*),	1	–	–	94.20	–	–	16.57	–	–	1.49	–	–	42.76	–	–	32.88	6.30	–
Serradella,	3	92.80	87.23	90.44	17.97	15.26	17.03	2.91	2.37	2.55	50.23	44.49	48.18	25.92	24.37	25.15	7.09	1:4.85
Hairy vetch (*Vicia villosa* Roth.),	1	–	–	92.56	–	–	19.58	–		1.22	–	–	38.95	–	–	31.88	8.37	–
Common vetch (*Vicia sativa* L.),	2	91.65	90.55	91.10	15.76	14.42	15.09	2.69	2.30	2.50	44.34	43.29	43.80	30.68	30.05	30.37	8.24	1:3.87
Scotch tares,	1	–	–	84.20	–	–	22.00	–	–	1.89	–	–	31.46	–	–	30.89	13.76	–
Vetch and oats,	2	94.22	87.47	90.85	7.72	7.70	7.71	3.37	2.53	2.95	49.95	49.00	49.47	36.22	31.73	33.98	5.89	1:11.49
Horse-bean straw,	1	–	–	90.85	–	–	9.69	–	–	1.51	–	–	37.77	–	–	41.44	9.59	1:8.55
Soja-bean straw,	2	92.37	87.00	89.68	5.39	5.34	5.36	3.49	1.80	2.64	43.72	43.65	43.70	43.85	36.80	40.32	7.98	–
White daisy (*Chrysanthemum leucanthemum* L.),	1	–	–	90.35	–	–	7.68	–	–	2.32	–	–	46.86	–	–	36.09	7.05	–
Dry carrot tops,	1	–	–	90.24	–	–	20.12	–	–	2.01	–	–	50.39	–	–	13.61	13.87	–
Wheat straw,	1	–	–	93.80	–	–	7.20	–	–	1.63	–	–	50.46	–	–	35.91	4.80	1:8.00
Barley straw,	1	–	–	88.56	–	–	9.24	–	–	3.38	–	–	48.23	–	–	33.85	5.30	1:26.21
Japanese millet (white head),	1	–	–	91.48	–	–	7.67	–	–	2.41	–	–	49.87	–	–	34.99	5.06	–
Japanese millet (red head),	1	–	–	91.13	–	–	5.76	–	–	1.70	–	–	49.66	–	–	39.52	3.36	–

A. *Analyses of Fodder Articles* — Continued.

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain — Protein.			Fat.			Nitrogen-free Extract.			Fibre.			Ash.	Nutritive Ratio (Average).
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
II. Hay and Dry Coarse Fodders — Concluded.																		
Straw (*Panicum crus-galli*),	1	-	-	87.35	-	-	6.10	-	-	2.44	-	-	50.20	-	-	35.90	5.36	-
Straw (*P. miliaceum*),	1	-	-	87.83	-	-	3.94	-	-	3.01	-	-	44.72	-	-	42.16	6.17	-
Straw (*P. Italicum*),	1	-	-	80.28	-	-	4.17	-	-	1.59	-	-	46.39	-	-	41.54	6.31	-
III. Roots, Bulbs, Tubers, etc.																		
Beets, red,	7	14.51	9.75	12.17	15.40	7.82	12.29	1.76	.59	.94	79.33	66.87	72.19	7.56	4.29	6.00	8.58	-
Beets, sugar,	12	19.53	9.87	14.60	17.44	7.32	11.18	.83	.58	.67	81.50	61.93	75.62	9.69	4.82	6.55	5.98	1:7.41
Mangolds,	3	13.08	11.73	12.25	12.84	7.83	10.37	1.01	.73	.88	73.38	70.32	71.75	9.54	7.08	7.94	9.06	-
Beets, yellow fodder,	4	15.01	9.40	11.46	13.96	9.29	11.69	2.02	.84	1.39	75.22	61.90	69.33	9.66	7.26	8.14	9.45	-
Ruta-bagas,	3	12.77	8.25	10.88	11.46	10.34	11.01	2.32	1.23	1.53	68.58	62.27	65.88	13.12	11.03	11.83	9.75	1:11.83
Turnips,	3	12.80	8.22	9.79	10.81	9.67	10.12	2.05	1.42	1.74	70.62	65.91	68.44	12.61	10.12	11.23	8.47	1:13.26
Carrots,	4	12.52	9.95	10.72	9.63	7.98	8.93	3.94	1.67	2.34	73.96	67.24	71.27	10.76	7.55	9.19	8.27	1:9.67
Parsnips,	1	-	-	19.66	-	-	6.88	-	-	3.37	-	-	74.65	-	-	-	7.67	-
Potatoes,	10	21.95	13.91	18.78	13.56	6.24	10.01	.83	.17	.48	87.56	78.80	81.50	3.55	1.91	2.75	5.26	1:12.25
Apples,	2	24.83	19.68	22.26	4.57	3.92	4.25	2.81	1.71	2.26	86.21	83.44	84.81	7.05	6.14	6.60	2.08	1:26.44

IV. Grains and Other Seeds.																		
Corn kernels,	29	91.98	65.50	89.43	15.02	8.49	12.18	9.43	4.25	5.42	83.98	71.06	78.49	3.38	1.03	2.12	1.69	1:8.16
Sweet corn kernels,	1	-	-	88.02	-	-	12.57	-	-	9.56	-	-	73.83	-	-	2.41	1.63	-
Corn and cob meal,	37	94.00	80.89	89.47	15.06	7.82	10.01	5.27	3.36	4.19	81.41	70.13	76.62	10.41	5.63	7.54	1.64	-
Wheat kernels,	1	-	-	89.42	-	-	13.35	-	-	1.79	-	-	80.20	-	-	2.42	2.18	1:6.42
Broom corn seed,	1	-	-	85.90	-	-	11.21	-	-	4.05	-	-	74.05	-	-	8.34	2.35	-
Soja beans,	3	94.15	80.73	85.83	35.98	32.58	33.97	21.89	18.42	20.19	34.88	32.87	33.98	7.57	5.15	6.02	5.84	1:2.61
Horse beans,	1	-	-	89.72	-	-	30.03	-	-	1.11	-	-	56.48	-	-	8.11	4.27	1:2.24
Red adzinki beans,	2	85.18	83.10	84.14	25.14	23.75	24.45	.88	.76	.82	66.48	65.41	65.95	4.68	4.50	4.59	4.19	-
Saddle beans,	1	-	-	87.62	-	-	15.12	-	-	16.58	-	-	57.34	-	-	4.75	6.21	-
Daidzu beans,	1	-	-	88.47	-	-	38.99	-	-	18.59	-	-	30.41	-	-	4.97	7.04	-
Millet seed,	3	87.32	86.11	86.65	14.60	11.76	13.24	4.94	3.53	4.32	73.19	66.94	70.56	10.23	6.48	8.88	3.00	-
Chestnuts,	1	-	-	55.14	-	-	13.32	-	-	14.46	-	-	67.05	-	-	2.45	2.72	-
V. Flour and Meal.																		
Corn meal,	29	89.95	82.96	86.39	16.08	9.73	11.07	5.08	3.10	4.49	83.24	73.20	80.59	3.60	1.20	2.15	1.58	-
Hominy meal,	4	-	-	90.00	4.15	3.00	3.57	.67	.38	.57	63.62	60.58	61.78	33.77	31.36	32.93	1.21	1:30.85
Ground barley,	4	89.09	82.59	86.44	14.93	10.42	12.46	2.38	1.69	2.10	78.25	74.47	76.83	7.37	4.10	5.84	2.77	-
Broom-corn meal,	1	-	-	86.46	-	-	11.14	-	-	4.13	-	-	74.30	-	-	8.00	2.43	-
Pea meal,	1	-	-	91.15	-	-	20.95	-	-	1.67	-	-	55.02	-	-	19.42	2.94	-
Bean meal,	1	-	-	88.02	-	-	12.57	-	-	9.56	-	-	73.83	-	-	2.41	1.63	-
Millet meal (*Panicum Italicum*),	1	-	-	89.38	-	-	35.12	-	-	17.35	-	-	38.95	-	-	3.86	4.72	-

A. *Analyses of Fodder Articles* — Concluded.

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain — Protein.			Fat.			Nitrogen-free Extract.			Fibre.			Ash.	Nutritive Ratio (Average).
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
VI. By-products and Refuse.																		
Linseed cake, old process,	7	92.52	88.50	90.54	39.97	30.98	36.64	9.87	6.24	7.16	44.72	37.76	40.61	9.69	8.04	8.68	6.91	1:1.66
Linseed cake, new process,	5	94.94	88.17	92.05	41.02	35.03	39.18	4.08	2.17	3.12	46.49	40.83	41.87	10.31	8.93	9.38	6.45	1:1.32
Cotton-seed meal, decorticated,	19	94.31	88.81	91.69	51.79	36.54	44.21	14.72	9.47	12.26	35.84	20.22	28.04	10.83	5.87	7.94	7.55	-
Wheat bran,	35	92.58	86.30	89.51	20.54	15.67	17.78	6.08	2.80	5.00	62.18	51.77	59.32	14.26	7.49	10.89	7.01	-
Wheat middlings,	6	90.75	87.57	89.93	19.21	15.13	16.72	6.46	3.19	5.31	74.30	58.03	61.77	11.21	1.40	9.21	6.99	1:4.21
Rye bran,	2	91.82	86.30	89.06	18.98	16.52	17.75	3.03	2.07	2.55	73.56	69.24	71.70	4.54	3.46	4.00	4.30	1:4.88
Rye middlings,	1	-	-	87.46	-	-	13.15	-	-	5.61	-	-	73.52	-	-	3.70	4.02	1:7.28
Buckwheat middlings,	1	-	-	88.49	-	-	25.49	-	-	7.53	-	-	66.36	-	-	5.18	5.44	-
Gluten meal,	26	93.50	68.32	90.65	39.28	25.75	31.42	12.05	3.92	8.18	66.26	48.26	57.48	6.39	.41	2.14	.78	-
Maize feed,	3	91.40	90.25	90.95	29.40	21.33	25.47	7.90	6.15	6.96	62.12	53.85	58.27	9.65	7.93	8.53	.77	-
Corn germ meal,	1	-	-	90.65	-	-	28.26	-	-	11.82	-	-	42.49	-	-	9.18	8.25	-
Corn germ feed,	1	-	-	92.45	-	-	10.81	-	-	12.17	-	-	62.10	-	-	14.05	.87	-
Corn screenings,	1	-	-	88.98	-	-	8.29	-	-	4.48	-	-	81.57	-	-	3.27	2.39	-
Oat feed,	1	-	-	90.66	-	-	14.06	-	-	8.23	-	-	66.52	-	-	8.79	4.40	-
Cocoanut meal,	1	-	-	90.67	-	-	22.61	-	-	12.88	-	-	40.03	-	-	18.80	5.68	-
Bakery refuse,	1	-	-	86.66	-	-	9.23	-	-	6.36	-	-	72.34	-	-	.43	11.64	-

Vinegar mash,	1	-	-	5.51	-	-	16.50	-	-	8.45	-	-	63.47	-	-	8.55	3.03	-
Refuse from starch works,	1	-	-	42.96	-	-	22.41	-	-	10.17	-	-	58.98	-	-	7.54	.90	-
Spent brewers' grain,	4	93.02	88.00	90.13	33.16	16.08	23.29	6.29	1.95	4.89	67.62	42.32	54.04	15.90	8.07	11.25	4.53	1:2.90
Malt sprouts,	1	-	-	84.63	-	-	27.17	-	-	3.85	-	-	47.92	-	-	14.75	6.31	-
Cocoa dust from cocoa manufactory,	1	-	-	92.90	-	-	15.47	-	-	25.85	-	-	45.99	-	-	5.86	6.83	-
Broom-corn waste,	1	-	-	91.30	-	-	6.78	-	-	1.00	-	-	48.09	-	-	39.25	4.88	-
Cotton hulls,	2	89.83	88.55	89.10	5.36	4.90	5.13	4.27	2.36	3.31	46.75	38.59	42.67	51.40	40.24	45.82	3.07	1:28.16
Apple pomace,	2	21.78	17.22	19.50	7.73	6.94	7.34	4.37	3.17	3.78	72.93	70.20	72.56	16.58	13.15	14.86	1.46	-
Apple pomace ensilage,	1	-	-	14.67	-	-	8.22	-	-	7.36	-	-	58.03	-	-	22.18	4.21	-
Sugar beet pulp from diffusion battery,	1	-	-	10.32	-	-	12.41	-	-	.95	-	-	61.86	-	-	23.74	1.04	-
Corn cobs,	6	94.05	90.00	92.35	4.15	1.46	2.91	.77	.38	.56	63.62	58.78	61.21	37.84	31.36	33.96	1.36	-
Palmetto root,	1	-	-	88.49	-	-	3.82	-	-	.53	-	-	69.95	-	-	21.26	4.44	-

B. *Analyses of Fodder Articles with Reference to Fertilizing Ingredients.*

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	*Valuation per 2,000 Pounds.
i. Green Fodders.												
Fodder corn,	14	78.61	.407	4.84	.327	.048	.153	.091	.018	.148	.380	$1 65
Fodder corn ensilage,	2	77.95	.278	-	.368	.050	.100	990	.020	.113	.040	1 29
Corn and soja bean ensilage,	1	71.03	.790	-	.444	-	-	-	-	.420	-	3 23
Sorghum,	7	82.19	.233	-	.229	.025	.076	.075	.012	.088	.136	1 00
White kibi,	2	76.45	.489	1.22	.200	.045	.232	.148	.019	.136	.652	1 79
Mochi millet,	3	62.58	.609	2.62	.407	.120	.201	.217	.021	.188	.708	2 50
Mix,	3	75.59	.499	1.54	.363	.060	249	.245	.021	.237	.527	2 08
Green oats,	3	83.36	.489	1.31	.381	.217	.154	.134	.018	.130	.496	1 95
Green rye,	1	62.11	.326	-	.734	-	-	-	-	.150	-	1 80
Vetch and oats,	1	86.11	.236	1.72	.789	.031	.087	.030	.012	.094	.331	1 53
Horse bean,	1	74.71	.675	-	1.370	.090	1.370	.620	.200	.330	2.040	3 62
Soja bean,	1	73.20	.292	-	.531	-	-	-	-	.151	-	1 61
Cow-pea vines,	1	78.81	.274	1.47	.306	.063	.300	.099	.016	.098	.077	1 21
Serradella,	2	82.59	.411	1.82	.420	.097	.460	.067	.021	.140	.097	1 77
Hungarian grass,	1	74.31	.386	-	.549	-	-	-	-	.159	-	1 87

White lupine,	1	85.35	.440	-	1.730	.680	3.070	.730	.170	.350	.900	3 26
Spanish moss,	1	60.80	.279	1.04	.255	.263	.089	.122	.029	.030	.191	1 10
II. Hay and Dry Coarse Fodders.												
English hay,	9	11.99	1.409	6.34	1.550	.110	.344	.240	.021	.269	.980	$5 92
Rowen,	12	18.52	1.609	9.57	1.486	.140	.640	.280	.034	.432	1.840	5 64
Timothy hay,	3	11.26	1.240	4.93	1.460	.180	.620	.120	.006	.342	1.000	5 41
Red-top,	4	7.71	1.150	4.59	1.020	.438	.571	.134	.036	.360	1.736	4 76
Kentucky blue-grass,	2	5.34	1.320	-	1.694	.129	.398	-	.044	.431	2.863	5 95
Orchard grass,	4	8.84	1.310	6.42	1.879	.225	.456	.297	.033	.414	2.060	6 08
Meadow fescue,	6	8.89	.992	8.08	2.096	.301	.576	.187	.028	.399	1.537	5 30
Perennial rye-grass,	2	9.13	1.227	6.79	1.553	.307	.642	.337	.044	.559	2.262	5 69
Italian rye-grass,	4	8.71	1.189	-	1.273	.451	.857	.321	.071	.556	2.598	5 32
Salt hay,	1	5.36	1.180	-	.718	.017	.371	.335	.028	.248	-	4 46
Japanese millet (white head),	3	10.45	1.105	5.80	1.223	.012	.465	.377	.028	.403	1.033	4 86
Japanese buckwheat,	1	5.72	1.629	-	3.320	.349	3.418	.421	.148	.852	.378	8 81
Fodder corn,	7	7.85	1.763	4.91	.889	.175	.605	.500	.075	.542	1.270	6 69
Corn stover,	16	9.12	1.043	3.74	1.400	.112	.622	.384	.068	.293	1.885	4 71
Teosinte,	1	6.06	1.460	6.53	3.696	.109	1.597	.458	.021	.546	.315	8 31
Millet hay,	1	9.75	1.280	-	1.690	.020	.500	.460	.030	.490	1.360	5 90
Mammoth red clover,	3	11.41	2.231	8.72	1.223	.389	3.141	.613	.111	.546	.779	8 39

* The valuation is based on the following prices per pound of the essential fertilizing ingredients: Nitrogen, 15 cents; potassium oxide, $4\frac{1}{2}$ cents; phosphoric acid, $5\frac{1}{2}$ cents.

B. Analyses of Fodder Articles with Reference to Fertilizing Ingredients — Continued.

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Valuation per 2,000 Pounds.
II. Hay and Dry Coarse Fodders — Concluded.												
Medium red clover,	2	7.91	2.184	8.36	2.286	.210	1.689	.402	.099	.447	.919	$9 10
Alsike clover,	6	9.94	2.342	11.11	2.227	.309	2.153	.537	.197	.668	1.776	9 77
Lucerne (alfalfa),	4	6.26	2.075	6.82	1.461	.814	2.211	.406	.078	.526	.513	8 12
Bokhara clover,	2	7.43	1.975	7.70	1.832	.114	1.784	.347	.023	.558	.057	8 19
Blue melilot,	1	8.22	1.919	13.65	2.796	.270	1.449	.260	.349	.544	4.008	8 87
Sainfoin,	1	12.17	2.630	7.55	2.020	.540	1.160	.430	.040	.760	.470	10 54
Sulla,	2	9.39	2.460	-	2.093	.223	2.497	.350	.114	.453	.614	9 76
Lotus villosus,	2	11.52	2.095	8.23	1.807	.499	2.220	.476	.112	.594	.976	8 56
Soja bean,	2	6.30	2.320	6.47	1.079	.148	2.760	1.178	.115	.667	.977	8 66
Cow-pea,	1	9.00	1.635	8.40	.913	.122	2.696	.688	.046	.527	.832	6 31
Small pea,	1	5.80	2.497	-	1.990	.469	1.373	.276	.138	.592	1.081	9 93
Serradella,	2	7.39	2.697	10.60	.652	.656	2.545	.461	.066	.777	.590	9 83
Scotch tares,	1	15.80	2.964	-	3.004	.238	1.698	.354	.460	.815	4.062	12 49
Vetch and oats,	3	9.91	1.299	9.58	1.349	.420	.663	.265	.098	.560	.521	5 72
Soja-bean straw,	1	13.00	.750	-	1.322	-	.436	.469	.035	.397	.218	3 88
White daisy,	1	9.65	.279	6.37	1.253	.164	1.302	.191	.032	.435	1.110	2 44

Dry carrot tops,	1	9.76	3.130	12.52	4.883	4.028	2.089	.667	.118	.612	.098	14 46
Barley straw,	1	11.44	1.310	5.30	2.086	.183	.572	.180	-	.303	2.380	6 14
III. Roots, Bulbs, Tubers, etc.												
Beets, red,	7	87.73	.243	1.13	.436	.091	.049	.033	.004	.091	.020	$1 22
Beets, sugar,	4	86.95	.223	1.04	.477	.081	.057	.040	.013	.101	.048	1 21
Beets, yellow fodder,	1	90.60	.192	.95	.462	.104	.045	.030	.005	.086	.015	1 09
Mangolds,	2	87.29	.188	1.22	.383	.125	.061	.039	.005	.093	.023	1 01
Ruta-bagas,	3	89.13	.190	1.06	.489	.070	.088	.030	.004	.123	.012	1 15
Turnips,	2	89.49	.178	1.01	.385	.078	.089	.027	.009	.104	.055	0 99
Carrots,	2	89.79	.147	9.22	.506	.062	.067	.023	.009	.093	.019	1 00
Parsnips,	1	80.34	.217	-	.617	.006	.088	.045	.005	.187	.019	1 41
Potatoes,	1	79.75	.207	.99	.294	.013	.007	.020	.002	.066	.006	0 96
Apples,	2	79.91	.130	.41	.190	.030	.030	.030	.003	.010	.003	0 57
IV. Grain and Other Seeds.												
Corn kernels,	13	10.88	1.822	1.53	.404	.034	.032	.206	.019	.699	.020	$6 60
Corn and cob meal,	29	8.96	1.409	-	.472	.059	.018	.176	.011	.571	.430	5 28
Soja beans,	2	18.33	5.303	4.99	1.991	.275	.419	.909	.216	1.869	.093	19 75
Red adzinki beans,	1	14.82	3.240	-	1.540	.035	.090	.210	.180	.940	.050	12 14
White adzinki beans,	1	16.90	3.330	-	1.480	.190	.130	.220	.021	.970	.130	12 39
Saddle beans,	1	12.38	2.120	-	2.130	.020	.250	.430	.032	1.520	.250	9 95
Daidzu beans,	1	11.53	5.520	-	1.960	.210	.220	.400	.050	1.480	.280	19 95

B. Analyses of Fodder Articles with Reference to Fertilizing Ingredients — Concluded.

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Valuation per 2,000 Pounds.
IV. Grain and Other Seeds — Concluded.												
Japanese millet,	2	13.68	1.730	-	.380	.030	.045	.225	.015	.685	-	$6 22
Common millet,	1	12.68	2.040	-	.360	.060	.040	.260	.030	.850	.143	7 38
Chestnuts,	1	44.86	1.175	2.72	.632	-	.060	.135	.010	.392	.069	4 53
V. Flour and Meal.												
Corn meal,	2	13.52	2.050	1.42	.435	.064	.034	.187	.015	.707	.005	$7 31
Hominy feed,	1	8.93	1.630	2.21	.490	-	.180	.280	-	.980	-	6 41
Ground barley,	1	13.43	1.550	2.06	.341	.169	.091	.173	.013	.660	.669	5 68
Wheat flour,	1	9.83	2.210	1.22	.540	-	.170	.050	-	.570	-	7 74
Pea meal,	1	8.85	3.080	2.68	.993	.618	.302	.302	.027	.820	.122	11 04
VI. By-products and Refuse.												
Linseed cake, old process,	4	8.02	5.390	6.57	1.214	.860	.664	.763	.060	1.780	.340	$19 22
Linseed cake, new process,	4	7.35	5.808	5.04	1.288	.823	.663	.655	.062	1.628	.345	20 37
Cotton-seed meal,	9	8.96	6.467	6.49	1.723	.291	.587	.589	.020	2.333	.457	23 52
Wheat bran,	5	11.39	2.879	6.44	1.625	.159	.168	.899	.019	2.845	.141	13 23
Wheat middlings,	1	9.18	2.630	2.30	.630	.110	.200	.210	-	.950	-	9 50

Rye middlings,	1	12.54	1.840	3.52	.810	.030	.090	.320	.020	1.260	.170	7 63
Gluten meal,	5	8.53	5.090	.65	.047	.018	.050	.035	.009	.420	-	15 77
Spent brewers' grain,	2	8.58	2.680	6.15	.853	.347	.296	.286	.159	1.045	1.770	9 96
Cocoa dust,	1	7.10	2.299	6.35	.630	-	.630	-	-	1.340	-	8 94
Broom corn waste (stalks),	1	10.37	.870	4.70	1.858	-	.242	.170	-	.460	1.000	4 79
Cotton hulls,	3	10.63	.750	2.61	1.080	-	.200	.260	-	.180	.060	3 42
Apple pomace,	2	80.50	.227	.271	.134	.026	.037	.028	.008	.018	.009	0 82
Corn cobs,	8	12.09	.504	.815	.598	.071	.025	.045	.009	.063	.190	2 12
Palmetto roots,	1	11.51	.540	3.93	1.380	.345	.045	.004	.017	.157	.410	3 03
Buckwheat hulls,	1	11.90	.490	-	.521	-	.247	.236	.020	.073	.066	2 02

C. Analyses of Fruits.

NAME.	Date.	Dry Matter.	Specific Gravity of Juice.	Temperature C. of Juice (Degrees).	Total Sugar in Juice.	Glucose in Juice.	Cane Sugar in Juice.	*Soda Sol. required to neutralize 100 parts Juice.
	1877.	Per ct.			Per ct.	Per ct.	Per ct.	C. C.
Apple (Baldwin), ...	Sept. 1,	20.14	1.055	12—15	3.09	–	–	–
Apple (Baldwin), ...	Oct. 9,	19.66	1.065	12—15	6.25	–	–	–
Apple (Baldwin), ...	Nov. 27,	–	1.075	12—15	10.42	–	–	–
Rhode Island Greening, . .	Sept. 1,	20.27	1.055	12—15	3.16	–	–	–
Rhode Island Greening, . .	Oct. 9,	19.68	1.066	12—15	7.14	–	–	–
Rhode Island Greening,† . .	Nov. 27,	20.25	1.080	12—15	11.36	–	–	–
Pear (Bartlett), ...	Aug. 31,	15.00	1.060	12—15	4.77	–	–	–
Pear (Bartlett), ...	Sept. 7,	16.55	1.060	12—15	5.68	–	–	–
Pear (Bartlett), ...	Sept. 20,	–	1.065	12—15	8.62	–	–	–
Pear (Bartlett),‡	Sept. 22,	–	1.060	12—15	8.93	–	–	–
Cranberries, ...	–	10.71	1.025	15	1.35	–	–	–§
Cranberries, ...	1878.	10.11	1.025	15	1.70	–	–	–‖
Early York Peach (ripe), .	–	–	1.045	25	–	1.92	6.09	45
Early York Peach (nearly ripe),	–	10.96¶	1.039	25	–	1.36	4.12	42.3
Crawford Peach (nearly ripe),	–	–	1.050	18	–	2.19	7.02	85.6
Crawford Peach (mellow), .	–	11.36¶	1.055	18	–	1.70	8.94	76
Crawford Peach (not mellow),	–	11.88¶	1.045	22	–	1.67	5.92	64

* One part Na_2CO_3 in 100 parts of water.
† Picked October 9.
‡ Picked September 7.
§ Free acid, 2.25 per cent.
‖ Free acid, 2.43 per cent.
¶ In pulp, kept ten days before testing.

C. Analyses of Fruits — Continued.

[Wild and cultivated grapes.]

NAME.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter.	Glucose in Juice.	Sugar in Dry Matter.	*Soda Sol. required to neutralize 100 parts Juice.
	1876.			Per ct.	Per ct.	Per ct.	C.C.
Concord,	July 17,	1.0175	31	8.30	.645	7.77	-
Concord,	July 20,	1.0150	31	8.10	.625	7.72	216
Concord,	Aug. 2,	1.0200	25	9.94	.938	9.44	249
Concord,	Aug. 16,	1.0250	28	10.88	2.000	18.38	229
Concord,	Aug. 30,	1.0500	25	15.58	8.620	55.33	120
Concord,	Sept. 13,	1.0670	23	17.48	13.890	79.46	55
Concord,	Sept. 4,	1.0700	18	19.82	16.130	81.38	49.2
Wild Purple Grape,	July 19,	1.020	31	9.00	.714	7.93	204
Wild Purple Grape,	Aug. 4,	1.020	28	12.25	1.100	8.98	246
Wild Purple Grape,	Aug. 16,	1.025	28	12.48	2.000	16.03	233
Wild Purple Grape,	Aug. 30,	1.050	26	16.58	6.500	39.81	147.6
White Wild Grape,	Aug. 31,	1.050	26	16.48	9.260	56.18	98
Hartford Prolific,	Sept. 5,	1.060	22	17.39	13.89	79.87	88.8
Ives' seedling,	Sept. 6,	1.070	26	20.15	15.15	75.14	88.6
Iona,	Sept. 7,	1.080	21	24.56	15.15	61.68	144
Iona (mildewed),	Sept. 7,	1.045	26	15.41	6.25	40.56	204.4
Agawam,	Sept. 11,	1.075	20	20.79	17.24	82.92	94.8
Wilder,	Sept. 11,	1.064	20	16.53	13.67	82.69	56
Delaware,	Sept. 12,	1.080	24	23.47	17.86	76.09	74
Charter Oak,	Sept. 12,	1.080	24	15.98	8.77	54.94	168.3
Israella,	Sept. 16,	1.075	23	19.67	9.20	46.77	89.8
Bent's Seedling,	Sept. 20,	1.080	21	20.65	16.13	78.11	181.8
Adirondack,	Sept. 20,	1.065	21	15.11	13.17	87.16	68
Catawba,	Oct. 16,	1.080	13	23.45	17.39	74.16	82
	1877.						
Wilder,	Sept. 11,	1.065	23	16.41	15.15	92.32	60
Charter Oak,	Sept. 12,	1.055	23	16.22	9.80	60.42	96
Concord,	Sept. 13,	1.065	24	15.90	13.16	82.76	102
Concord,	Sept. 26,	1.075	24	19.34	15.43	79.78	70.8
Eumalan,	Sept. 24,	1.065	16	19.62	13.16	67.07	73
Wild White Grape,	Sept. 5,	1.050	22	15.57	7.20	46.24	140.8
Wild White Grape (shrivelled),	Sept. 20,	1.060	16	20.02	10.00	49.95	130
Wild Purple Grape (shrivelled),	Sept. 20,	1.045	16	16.69	8.22	49.25	104

* One part of pure Na_2CO_3 in 100 parts water.

C. Analyses of Fruits — Continued.

[Effect of girdling on grapes.]

NAME AND CONDITION.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter at 100° C.	Glucose in Juice.	Sugar in Dry Matter.	*Soda Sol. required to neutralize 100 parts Juice.
	1877.			Per ct.	Per ct.	Per ct.	C. C.
Hartford Prolific, not girdled,	Sept. 3,	1.045	19	12.85	8.77	68.25	111.4
Hartford Prolific, girdled,	Sept. 3,	1.065	19	17.18	12.50	72.76	100
Wilder, not girdled,	Sept. 3,	1.055	19	15.41	10.42	67.62	108.2
Wilder, girdled,	Sept. 3,	1.075	19	17.24	14.70	85.26	88.4
Delaware, not girdled,	Sept. 4,	1.065	19	15.75	11.76	74.66	101.2
Delaware, girdled,	Sept. 4,	1.075	19	19.14	15.15	79.16	94.4
Agawam, not girdled,	Sept. 4,	1.060	19	16.60	11.37	68.48	128.2
Agawam, girdled,	Sept. 4,	1.075	19	18.45	16.31	87.42	114.8
Iona, not girdled,	Sept. 6,	1.0625	22	16.60	13.51	68.31	131.4
Iona, girdled,	Sept. 6,	1.085	22	21.48	15 63	72.76	125.6
Concord, not girdled,	Sept. 6,	1.045	22	13.46	7.46	55.42	182.4
Concord, girdled,	Sept. 6,	1.070	22	17.53	13.88	79.18	102.8
Concord, not girdled,	Sept. 26,	1.065	22	17.63	13.70	78.27	86
Concord, girdled,	Sept. 26,	1.080	22	24.47	19.61	80.13	76.8
Concord, not girdled,	Oct. 5,	1.075	12	20.92	17.50	85.37	42
Concord, girdled,	Oct. 5,	1.085	12	–	17.86	–	54

	Date.	100 Parts of Grapes contained — Ash.	Moisture.	Glucose.	Tartaric Acid.
	1889.				
Concord, not girdled,	Sept. 23,	–	84.69	6.24	.75
Concord, girdled,	Sept. 23,	.42	83.00	8.13	.85
Concord, not girdled,	Oct. 8,	.53	84.51	6.09	.48
Concord, girdled,	Oct. 8,	.37	82.69	8.50	.50
	1890.				
Concord, not girdled,	Sept. 25,	.47	86.49	7.36	1.15
Concord, girdled,	Sept. 25,	.48	84.93	9.29	1.17
Concord, not girdled,	Oct. 9,	.53	85.39	7.67	.71
Concord, not girdled,	Oct. 9,	.59	85.11	6.65	.51
Concord, girdled,	Oct. 9,	.54	85.15	9.12	.74

* One part of pure $Na_2\ CO_3$ in 100 parts water.

C. Analyses of Fruits — Continued.

[Effect of fertilization upon the organic constituents of wild grapes.]

NAME.	Date.	Dry Matter.	Specific Gravity.	Temperature C. (Degrees).	Per Cent. of Glucose.	Per Cent. of Acids.	Remarks.
	1877.						
Wild Purple Grape Berries, .	Sept. 20,	16.31	-	-	8.03	-	Unfertilized.
Wild Purple Grape Berries, .	"	19.55	-	-	13.51	-	Fertilized.
Wild Purple Grape Juice, .	"	-	1.045	16	8.22	9.840	Unfertilized.
Wild Purple Grape Juice, .	"	-	1.065	16	13.51	1.149	Fertilized.
Wild White Grape Berries, .	"	20.02	-	-	-	-	Unfertilized.
Wild White Grape Berries, .	"	21.65	-	-	-	-	Fertilized.
Wild White Grape Juice, .	"	-	1.060	16	10.00	1.846	Unfertilized.
Wild White Grape Juice, .	"	-	-	-	14.29	.923	Fertilized.

[Effect of fertilization upon the ash constituents of grapes.]

NAME.	Date.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Remarks.
	1876.								
Wild Purple Grapes,	Sept. 13,	50.93	.15	22.23	5.59	.79	17.40	2.93	Unfertilized.
Wild Purple Grapes,	Sept. 20,	62.65	.85	14.24	3.92	.53	13.18	4.63	Fertilized.
Concord Grapes, .	July 7,	41.73	5.04	25.03	7.80	.55	18.48	1.37	Unfertilized.
Concord Grapes, .	July 17,	47.34	1.13	24.21	-	.75	21.38	.43	Unfertilized.
Concord Grapes, .	Aug. 18,	51.14	3.19	16.20	6.38	.65	20.77	1.67	Unfertilized.
Concord Grapes, .	Sept. 13,	57.15	4.17	11.30	3.10	.40	12.47	11.82	Unfertilized.
	1878.								
Concord Grapes, .	Oct. 3,	64.65	1.42	9.13	3.63	.50	14.87	5.80	Fertilized.

C. *Analyses of Fruits* — Concluded.

[Ash analyses of fruits and garden crops.]

NAME.	Ash.	100 Parts of Ash contained —						
		Potash.	Soda.	Lime.	Magnesia.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.
Concord Grape (fruit),	–	51.14	3.19	16.20	6.38	.65	20.77	1.67
Unfermented juice,	–	50.85	.48	3.69	4.25	.10	6.43	.90
Fermented juice,	–	40.69	–	6.85	6.24	–	9.04	–
Skins and pulp,	–	7.70	.42	57.36	8.80	.08	24.40	1.32
Seeds,	3.08	6.71	–	–	3.03	–	17.20	.29
Stems of grapes,	4.69	20.91	–	20.20	8.45	–	17.75	2.09
Young branches,*	–	24.71	.94	40.53	10.66	1.08	17.16	4.92
Wood of viue,†	2.97	22.57	–	9.72	4.28	–	14.07	23.84
Coucord Grapes, 1891,‡	.55	49.76	–	3.50	2.53	1.19	13.56	2.01
Cliuton Grape (fruit),	–	58.45	3.51	13.34	7.37	.90	18.19	–
Baldwin Apple,	–	63.54	1.71	7.28	5.52	1.08	20.87	3.68
Strawberry (fruit),§	.52	49.24	3.23	13.47	8.12	1.74	18.50	5.66
Strawberry (fruit),‖	–	58.47	–	14.64	6.12	3.37	17.40	–
Strawberry vines,	3.34	10.62	13.35	36.63	3.83	6.91	14.48	14.17
Cranberry (fruit),	.18	47.96	6.58	18.58	6.78	–	14.27	–
Cranberry vines,	2.45	12.98	3.27	16.49	10.33	3.35	10.94	34.04
Currants, red,	.47	47.68	4.02	18.96	6.23	1.20	21.91	–
Currants, white,	.59	52.79	3.00	17.08	5.68	2.67	18.78	–
Crawford Peach, sound,	–	74.46	–	2.64	6.29	.58	16.02	–
Crawford Peach, diseased,¶	–	71.30	–	4.68	5.49	.46	18.07	–
Branch, sound,	–	26.01	–	54.52	7.58	.52	11.37	–
Branch, diseased,¶	–	15.67	–	64.23	10.28	1.45	8.37	–
Carnation Pinks (whole plant),**	8.80	38.07	12.84	18.64	3.98	.34	5.23	.24
Asparagus stems,	–	42.94	3.58	27.18	12.77	1.22	12.31	.08
Asparagus roots,	–	56.43	5.42	15.48	7.57	–	15.09	3.67
Onions,	–	38.51	1.90	8.20	3.65	.58	15.80	3.33

* With tendrils and blossoms.
† One year old.
‡ Nitrogen in dry matter, .96 per cent.
§ Wilder.
‖ Downing.
¶ Yellows.
** Nitrogen in dry matter, 1.15 per cent.

D. Analyses of Sugar-producing Plants.

[Composition of sugar beets raised upon the college grounds during the season of 1870 and 1871.]

NAME.	Date.	Brix Saccharometer (Degrees).	Per Cent. of Sugar.	Non-saccharine Substances.
Electoral,	Sept. 10,	14	12.30	1.75
Imperial,	" 12,	15	12.59	2.41
Vilmorin,	" 13,	14.5	12.95	1.55
Imperial,	" 18,	14	10.79	3.21
Imperial,	Oct. 11,	15	12.05	2.95
Electoral,	" 16,	15	12.22	2.78
Vilmorin,	" 18,	16	13.13	2.87
Imperial,	Nov. 14,	15	11.60	3.34
Vilmorin,	" 21,	15.5	13.12	2.38
Vienna Globe,*	Sept. 19,	11	8.00	3.00
Common Mangold,*	" 19,	9	5.00	3.97

* Fodder beets.

[Percentage of sugar in different varieties of sugar beets grown on college farm during the season of 1882.]

NAME.	Source of Seed.	Weight in Pounds.	Per Cent. of Sugar in Juice.
I. Vilmorin,	Saxony,	$\frac{3}{4}$ to $\frac{7}{8}$	15.50
II. Vilmorin,	Saxony,	$\frac{3}{4}$ to 1	15.61
I. White Imperial,	Saxony,	$\frac{3}{4}$ to $1\frac{3}{4}$	14.20
II. White Imperial,	Saxony,	$1\frac{3}{4}$ to 2	10.27
New Imperial,	Saxony,	$1\frac{1}{4}$ to $1\frac{3}{4}$	13.80
I. White Magdeburg,	Saxony,	$1\frac{1}{2}$ to 2	13.10
II. White Magdeburg,	Silesia,	$1\frac{1}{2}$ to $1\frac{3}{4}$	10.06
Quedlinburg,	Saxony,	$1\frac{1}{2}$ to $1\frac{3}{4}$	13.44
White Silesian,	Silesia,	$1\frac{1}{4}$ to $1\frac{1}{2}$	9.72

D. Analyses of Sugar-producing Plants — Continued.

[Effect of soil and fertilization on Electoral sugar beets.*]

SOIL.	MANURE.	Specific Gravity Brix (Degrees).	Per Cent. of Sugar in Juice.	Non-saccharine Substances.	Cane Sugar in Soluble Matter.
Sandy loam,	Fresh yard-manure,	16.5	12.50	4.00	75.08
Clayish loam,	Fresh yard-manure,	15.5	11.05	4.45	71.30
Warm alluvial,	Yard-manure and chemicals,	12.75	9.17	3.58	71.92
Warm alluvial,	Fresh hog-manure,	13.5	9.53	3.97	70.06
Light, sandy soil,	No manure,	18.5	13.73	4.77	74.21
Alluvial soil,	Brighton fish,	14.5	11.15	3.35	76.90
Heavy soil,	Yard-manure,	12.25	8.15	4.10	66.53
–	–	13.5	9.90	3.60	73.33

* Not raised on college farm (Connecticut valley).

[Effect of fertilization on sugar beets.*]

FERTILIZERS.	PERCENTAGES OF SUGAR IN JUICE.		
	Freeport.	Electoral.	Vilmorin.
Fresh horse-manure,	11.96	9.42	7.80
Blood guano without potash,	10.99	10.10	10.20
Blood guano with potash,	12.55	13.24	10.50
Kainite and superphosphate,	13.15	12.16	10.50
Sulphate of potash,	14.52	14.32	12.78
Second year after stable-manure,	13.49	12.78	12.19

* All were grown on the same soil, — sandy loam (college).

D. Analyses of Sugar-producing Plants — Continued.

[Effect of different modes of cultivation on Electoral sugar beets.]

Locality of Beet-field.	Date.	Brix Saccharometer (Degrees).	Per Cent. of Cane Sugar.	Non-saccharine Substances.
1. Sing Sing, N. Y.,	1872-73	11	7.80	3.20
2. Washington, N. Y.,	"	14	10.97	3.03
3. South Hartford, N. Y.,	"	15	11.70	3.30
4. Greenwich, N. Y.,	"	12	9.50	2.50
5. Frankfort, N. Y.,	"	13.5	11.00	2.50
6. Albion, N. Y.,*	"	18	15.10	2.90
Albion, N. Y.,†	"	14	9.70	4.30

* From beets weighing from 1½ to 2 pounds. † From beets weighing from 10 to 14 pounds.

1. Soil, loam resting on clayish hard-pan, had been for several years in grass. Tomatoes had been the preceding crop. Five hundred pounds of a phosphatic blood guano were applied before planting.

2. Soil, a clayish loam, had been ploughed seven inches deep. A liberal amount of rotten sheep-manure was placed in trenches and covered by running two furrows together, thus forming a ridge on which the seed were planted.

3. Soil, a gravelly loam, which had been richly manured with stable compost and twice ploughed before planting.

4. Soil, a sandy loam, underlaid by fine sand. The seed were planted on ridges, which covered trenches containing a little rotten stable-manure.

5. No details of modes of cultivation received.

6. Soil, a dark, reddish-brown, rich, deep, sandy loam. Clover had been raised for two years previous to a crop of carrots, which preceded the sugar beets. The beets were the second crop after the application of twenty loads of stable-manure per acre.

Composition of Canada-grown Sugar Beets.

[1872 and 1873.]

Where Grown.	Weight of Roots.	Specific Gravity of Juice (Brix).	Temperature of Juice.	Per Cent. of Cane Sugar in Juice.
Echaullon de Montreal,	2 to 2½ lbs.	15.4°	64° F.	11.38
Riviere du Loup,	2 to 3¼ lbs.	14.5°	63° F.	10.20
Chambly,	2 to 2½ lbs.	13.2°	63° F.	9.02
Maskinonge,	2 to 3 lbs.	13.4°	63° F.	8.83

D. Analyses of Sugar-producing Plants — Continued.

[Early Amber Cane.]

DATE.	CONDITION OF CANE.	Brix Saccharometer (Degrees).	Temperature C. (Degrees).	Glucose.	Cane Sugar.	Soda solution required to neutralize 100 parts of Juice.	Solids.
1879.				Per ct.	Per ct.	C. C.	Per ct.
Aug. 15,	No flower stalks in sight,*	4.2	27	2.48	None.	6.8	7.93
Aug. 16,	No flower stalks in sight,*	5.8	24	4.06	None.	9.0	11.10
Aug. 20,	Flower stalks developed,*	7.9	24	3.47	2.15	7.0	13.00
Aug. 24,	Flowers open,*	8.7	23	3.70	3.00	4.0	14.07
Aug. 27,	Plants in full bloom,*	10.0	25	3.65	4.13	10.0	15.48
Aug. 30,	Seed forming,*	9.5	30	4.00	3.81	9.5	16.14
Sept. 2,	Seed in milk,*	10.7	27	3.85	4.41	9.5	15.85
Sept. 9,	Seeds still soft,*	12.1	22	3.21	6.86	9.5	26.13
Sept. 9,	Stripped on Sept. 2,*	12.8	22	3.77	6.81	9.5	26.75
Sept. 18,	Left on field without stripping,*	13.2	22	3.57	7.65	–	–
Sept. 18,	Tops removed,*	13.8	22	3.16	8.49	–	–
Sept. 18,	Tops and leaves removed on Sept. 9,*	11.5	22	3.16	5.85	–	–
Sept. 18,	Tops removed; left on field 9 days,*	12.8	22	10.00	.60	–	–
Sept. 21,	Juice from the above,*	13.0	21	–	–	–	–
Sept. 23,	Juice from the above,*	15.0	18	–	–	–	–
Sept. 25,	Left on field 3 weeks,†	19.8	21	11.91	6.27	–	–
Sept. 28,	Left on field 3 weeks,†	17.8	12	16.60	–	–	–
Oct. 4,	Left on field 3 weeks,†	16.1	17	8.62	6.16	12.0	–
Oct. 7,	Freshly cut. Ground with leaves,†	16.7	20	4.16	9.94	6.8	–
Oct. 8,	Freshly cut. Stripped two weeks,†	12.8	17	5.16	5.27	7.0	–
Oct. 9,	Freshly cut. Stripped two weeks,†	18.4	17	7.57	–	10.6	–
Oct. 14,	Several weeks old,†	18.2	15	10.42	–	10.4	–
Oct. 18,	Several weeks old,†	15.1	23	7.57	–	–	–
Oct. 19,	Several weeks old,†	15.5	15	9.22	–	13.6	–
Oct. 22,	Several weeks old,†	16.2	16	8.30	–	–	–
Oct. 23,	Several weeks old,†	18.3	17	11.30	5.5	14.0	–
Oct. 24,	Several weeks old,†	16.6	15	8.63	–	9.0	–

		100 PARTS OF CANE CONTAINED —				
		Moisture.	Glucose.	Cane Sugar.	Total Sugar.	
1889.						
October,	Early Tennessee sorghum, mature,	77.43	1.79	3.21	5.00	Grown on station grounds.
October,	Price's new hybrid, ripe,	77.80	2.92	3.78	6.70	
October,	Kansas orange, green,	80.67	2.38	3.63	6.01	
October,	New orange, green,	78.30	2.96	3.85	6.81	
October,	Honduras, green,	77.55	3.08	4.01	7.09	

* Raised on the college farm. † Raised by farmers in the vicinity of the college.

D. Analyses of Sugar-producing Plants — Concluded.

[Composition of the juice of corn stalks and melons.]

VARIETY.	Specific Gravity.	Temperature C. (Degrees).	Glucose.	Cane Sugar in Juice.	Solids.
			Per ct.	Per ct.	Per ct.
Northern corn,*	1.023	27	4.35	0.28	15.18
Black Mexican sweet corn,† . .	1.048	27	2.06	7.02	17.44
Evergreen sweet corn,† . . .	1.052	–	4.85	5.70	20.38
Common sweet corn,‡ . . .	1.035	–	6.60	None.	–
Common yellow musk-melon,§ .	1.040	26	1.67	2.65	–
White-flesh water-melon, . .	1.025	18	2.91	2.16	–
Red-flesh water-melon, . . .	1.025	22	3.57	2.18	–
Red-flesh water-melon, . . .	1.025	19	3.84	1.77	–
Nutmeg musk-melon,‖ . . .	1.030	19	3.33	2.11	–
Nutmeg musk-melon,¶ . . .	1.050	20	2.27	5.38	–
Nutmeg musk-melon,** . .	1.030	19	2.50	1.43	–

* Tassels appearing.
† Ears ready for the table.
‡ Kernels somewhat hard.
§ Fully ripe.
‖ Not ripe.
¶ Ripe.
** Over-ripe.

E. Analyses of Dairy Products.

	Analyses.	Solids.			Fat.			Curd.			Salt.			Ash.
		Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	
Whole milk,	1,401	18.27	10.58	13.44	7.54	2.48	4.06	-	-	3.20	-	-	-	.70
Skim milk,	303	10.40	7.68	9.49	1.02	.20	.40	-	-	3.53	-	-	-	.80
Buttermilk,	24	9.86	7.40	8.19	.38	.15	.27	-	-	2.79	-	-	-	.80
Cream (from Cooley Creamer),	121	29.35	21.30	25.35	20.90	13.74	17.40	-	-	-	-	-	-	.62
Butter,	25	92.89	87.05	89.11	89.05	81.43	83.95	.89	.51	.66	6.45	3.46	4.74	-
Whole-milk cheese (Jersey),*	1	-	-	62.84	-	-	37.32	-	-	22.13	-	-	-	3.39
Whole-milk cheese,*	1	-	-	64.17	-	-	34.34	-	-	26.69	-	-	-	3.14
Cheese from milk skimmed after twelve hours' standing,*	1	-	-	62.70	-	-	27.81	-	-	30.37	-	-	-	4.52
Cheese from milk skimmed after twenty-four hours' standing,*	1	-	-	57.76	-	-	23.42	-	-	31.99	-	-	-	2.35
Cheese from milk skimmed after thirty-six hours' standing,*	1	-	-	56.05	-	-	17.67	-	-	33.24	-	-	-	5.14
Cheese from milk skimmed after forty-eight hours' standing,*	1	-	-	54.59	-	-	15.77	-	-	34.94	-	-	-	3.88
Cheese from skim-milk, with addition of buttermilk,*	1	-	-	51.62	-	-	18.35	-	-	28.63	-	-	-	4.64
Genuine oleomargarine cheese,*	1	-	-	62.10	-	-	31.66	-	-	25.94	-	-	-	4.50

* From analyses made in 1875.

E. *Salt for Meat Packing and Dairy Purposes.*

KIND AND SOURCE.	Moisture, 100° C.	Sodium Chloride.	Calcium Sulphate.	Calcium Chloride.	Magnesium Chloride.	Sodium Sulphate.	Magnesium Sulphate.	Insoluble Matter.	Remarks.
Rock salt of Pettite Anse, La.,	.330	98.882	.782	.004	.003	-	-	-	Sent on for examination.
Rock salt of Neyba, San Domingo, W. I.,	.300	98.330	1.480	-	.090	.070	.070	-	
Solar salt, Onondaga, N. Y.,	2.500	96.004	1.315	.092	.089	-	-	-	
Solar salt, Hocking Valley, O.,	2.130	97.512	None.	.234	.089	-	-	-	
Solar salt, Saginaw Valley, Mich.,	3.344	95.813	.316	.356	.140	-	-	-	
Solar salt from Kansas,	4.950	93.060	1.220	-	.240	.350	.180	-	
Solar salt, Lincoln County, Neb.,	1.200	98.130	.250	-	.080	.390	None.	-	
Common line and boiled salt, Onondaga, N. Y.,	3.000	95.353	1.355	.155	.136	-	-	-	
Common fine and boiled salt, Portsmouth, Mich.,	6.752	90.682	.805	.974	.781	-	-	-	
Common fine and boiled salt, Mason City, O.,	3.470	95.789	-	.614	.041	-	-	-	
Dairy and table salt, Ashton's (English),	0.760	97.652	1.430	-	.060	-	.048	.050	
Onondaga dairy salt,	0.700	97.832	1.263	-	.037	.026	.023	.120	
Fine salt, Bulletin 26, I.,	3.280	95.091	1.487	.032	.075	-	-	.035	
Fine salt, Bulletin 26, II.,	4.591	94.012	1.177	.143	.049	-	-	.028	
Fine salt, Bulletin 26, III.,	4.616	94.236	.999	.071	.026	-	-	.052	Salicylic acid: trace.
Dairy salt, sent on from Amherst, Mass.,	0.145	98.520	1.009	.189	.065	-	-	.072	
Ashton salt (sent on),	.760	97.650	1.430	-	.060	-	.050	.050	
Onondaga factory-filled (sent on),	.600	98.280	.910	-	-	.030	.060	.120	
Dairy salt, sent on from Amherst,	.505	98.202	.877	.168	.046	-	-	.202	
Rock salt from Retsof salt mines,	2.600	95.940	.420	.330	.010	-	-	.700	
Royal salt,	.880	97.877	1.108	.016	.010	-	-	.102	
Excelsior salt,	.320	98.009	1.644	.013	.014	-	-	.020	
Genesee salt,	.295	98.513	1.160	.010	.012	-	-	.010	
Genesee salt,	.235	98.563	1.137	.045	.020	-	-	-	
Bradley salt,	.200	98.575	1.185	.029	.007	-	-	-	
Higgins' Eureka salt,	.855	98.891	.906	.293	.055	-	-	-	
Worcester refined salt,	.565	97.935	1.376	.097	.027	-	-	-	

F. *Analyses of Insecticides.*

	Moisture.	Arsenious Oxide.	Copper Oxide.	Acetic Acid.	Nicotine.	Mercury.	Sulphur.	Sulphuric Acid.	Chlorine.	Calcium Oxide.	Potassium Oxide.	Ferric and Aluminic Oxides.	Insoluble Matter.
Paris green,	1.30	62.55	32.84	3.10	-	-	-	-	-	-	-	-	0.21
Paris green,	1.41	61.40	33.20	3.90	-	-	-	-	-	-	-	-	0.09
Paris green,	1.40	61.15	33.10	3.71	-	-	-	-	-	-	-	-	0.64
Paris green,	1.15	59.92	30.40	-	-	-	-	-	-	-	-	-	0.10
Paris green,	1.34	61.25	33.35	3.93	-	-	-	-	-	-	-	-	0.13
Paris green,	1.31	61.21	33.45	3.94	-	-	-	-	-	-	-	-	0.09
Paris green,	1.15	53.91	31.27	8.10	-	-	-	-	-	-	-	-	0.04
Paris green,	1.27	54.80	30.85	6.50	-	-	-	-	-	-	-	-	0.12
"Sulphatine,"	1.40	-	2.61	-	-	-	48.28	4.73	-	18.60	-	-	1.63
"Death to Rose Bugs,"	2.95	-	1.05	-	-	-	34.53	4.35	-	17.76	-	-	0.49
"Professor De Graff's Carpet Bug Destroyer,"	95.81	-	-	-	-	0.78	-	0.48	0.27	-	0.26	0.90	-
Tobacco liquor,	37.71	-	-	-	2.12	-	-	-	-	3.07	6.55	0.23	-
Tobacco liquor,	40.89	-	-	-	0.53	-	-	-	-	1.47	16.34	0.01	-
Tobacco liquor,	-	-	-	-	4.55	-	-	-	-	-	-	-	-
Tobacco liquor,	-	-	-	-	4.82	-	-	-	-	-	-	-	-
"Nicotinia,"	10.00	-	-	-	-	-	-	-	-	4.45	9.15	-	2.12
Hellebore,	-	-	-	-	-	-	-	-	-	-	-	-	2.34
Hellebore,	-	-	-	-	-	-	-	-	-	-	-	-	38.12
"Peroxide of Silicate,"	1.65	0.57	0.33	-	-	-	-	49.66	-	41.18	-	-	2.31

METEOROLOGY.

1892.

The meteorological observations have been continued as in previous years. The temperature, the force and the direction of the wind and the amount of cloudiness are recorded each day at 7 A.M., 2 P.M. and 9 P.M. During the summer months the reading of a wet-bulb thermometer takes place at the same times. Records are also taken of maximum and minimum temperatures, rainfall, and of casual meteorological phenomena.

Monthly and annual reports are sent to the headquarters of the signal service at Washington, D. C., and to the New England Meteorological Society. During the summer months partial monthly reports have been furnished also for the use of the secretary of the State Board of Agriculture.

At the beginning of the year there was no snow on the ground. After January 1 the total snowfall of the season amounted to thirty-four inches. The heaviest snow-storm during that time occurred on January 15, measuring seven inches. A storm giving six inches of snow occurred on February 11. The last storm, which was only a trace, fell on April 10.

The last frost of the season was on May 10, when the minimum thermometer registered 35° F.

The mean temperature during the first four months was 31.43° F., being a little over one degree lower than that of last year. The absolute minimum temperature was —10°, occurring on January 15.

The mean monthly range for the four months was 18.84° F., being 14.16° lower than that of the first four months of 1891. The prevailing wind was N. N. E. for January and February,

and N. W. for March and April. During the following four months, May, June, July and August, the mean temperature was 65.32° F., being 1.67° lower than that of the corresponding months of last year, while the mean range of temperature was 5° greater.

The absolute maximum temperature, viz., 94.5°, occurred on June 14. The minimum temperature was 30°, occurring on May 1. The cold wave in May was unfavorable to the germination of seeds, and was a set-back to general farming operations.

The total precipitation during the months of May, June, July and August was 17.97 inches. During the months of June and July the precipitation was slightly below the normal, and there were extreme ranges of temperature. The month of August was characterized by excessive rainfalls, the precipitation being much above the normal, and 2.03 inches more than that for August, 1891.

The month of September was very fair and pleasant, being free from severe storms, and there was no frost until the 30th, which was the first of the season. The precipitation was far below the normal. The prevailing wind was S. The temperature for October and November was about normal, while for December it was much below.

The precipitation for October and December was exceedingly small, but for November was above the normal. The total amount of snowfall during the month of November was 2.68 inches, and for December 2.75 inches. The first trace of snow for the season fell November 5. The total amount of precipitation during the year was below the normal, and was unevenly distributed. The largest amount of water falling in one month was 5.70 inches, — August; the smallest amount, 0.64 of an inch, in October; and only 0.65 of an inch fell in April, being an exceedingly small figure for that month.

Summary of Meteorological Observations, 1892.

	Temperature, Degrees Fahrenheit.														
	7 A.M.	2 P.M.	9 P.M.	Mean.	Maximum.	Minimum.	Absolute Maximum.	Date.	Absolute Minimum.	Date.	Greatest Daily Range.	Date.	Least Daily Range.	Date.	Mean Daily Range.
January,	19.03	28.68	23.29	23.55	33.27	13.82	55.0	2d, 14th	—10.0	17th	37.0	26th	5.0	13th	19.45
February,	19.90	31.52	25.65	25.69	30.80	16.59	46.5	26th	—8.0	18th	52.0	18th	3.0	3d	14.21
March,	25.30	37.00	30.70	31.00	39 60	22.20	59.0	26th	5.0	22d	34.0	31st	7.0	1st	17.40
April,	40.30	54.20	43.80	45.50	57.40	33.10	76.0	5th	22.0	25th	40.0	20th	11.0	29th	24.30
May,	50.40	61.80	53.80	55.00	64.04	43.90	81.0	31st	30.0	1st	35.0	18th	6.0	21st	20.14
June,	64.40	77.40	66.60	68.77	80.03	58.40	94.5	14th	40.5	11th	38.5	11th	9.0	27th	21.60
July,	64.84	79.50	67.24	69.75	82.00	59.50	92.0	26th, 28th, 29th	42.0	17th	34.0	21st	10.0	1st	22.50
August,	63.34	76.29	65.74	67.78	78.61	58.00	90.0	10th	51.5	15th, 16th	31.5	18th	7.0	27th	20.61
September,	52.30	69.90	57.70	59.30	71.60	46.51	79.0	18th, 19th, 25th	34.0	30th	41.0	31st	8.0	14th, 24th	25.08
October,	43.63	59.45	48.47	50.00	61.57	36.56	70.0	8th, 16th	23.5	25th	35.0	13th	11.0	17th	25.01
November,	34.25	42.27	36.67	37.46	45.77	29.00	66.0	18th	14.5	24th	29.5	7th	6.5	10th	16.80
December,	21.57	32.01	23.95	26.35	34.73	17.74	55.0	12th	—1.0	27th	31.0	27th	4.5	14th	6.99
Sums,	499.26	650.02	543.61	560.15	679.42	435.32	864.0	-	244.0	-	438.5	-	88.0	-	234.09
Mean,	41.61	54.17	45.30	46.68	56.62	36.28	72.0	-	20.33	-	36.5	-	7.3	-	19.51

1892.	Precipitation, Inches.					Mean Dew Point.	Relative Humidity. Per Cent.				Wind.	Character of Days.		
	Total Amount.	Date of Greatest Fall.	Total Snowfall.	Depth of Snow the 15th.	Depth of Snow at End of Month.		7 A.M.	2 P.M.	9 P.M.	Mean.	Prevailing Direction.	Clear.	Fair.	Cloudy.
January,	5.05	2d	13.00	8.50	2.00	-	-	-	-	-	N. NE.	9	7	15
February,	1.59	3d	14.00	15.00	2.00	-	-	-	-	-	N. NE.	8	12	9
March,	2.45	23d	7.00	-	-	-	-	-	-	-	N. W.	14	10	7
April,	0.65	21st	-	-	-	-	-	-	-	-	N. W.	12	14	4
May,	5.49	21st	-	-	-	-	-	-	-	-	S. W.	4	11	16
June,	3.04	23d	-	-	-	60.0	87	56	82	75	S. W.	7	10	13
July,	3.74	30th	-	-	-	61.2	81	60	81	74	S. W.	19	7	5
August,	5.70	27th	-	-	-	62.3	90	66	90	82	N.	12	15	4
September,	1.53	15th	-	-	-	50.6	72	62	83	72	S.	22	3	5
October,	0.64	9th	-	-	-	-	-	-	-	-	N.	16	8	7
November,	4.28	16th	2.68	-	-	-	-	-	-	-	N. W.	8	9	13
December,	1.05	8th	2.75	-	-	-	-	-	-	-	N. W.	10	16	5
Sums,	35.21	-	39.43	-	-	-	-	-	-	-	-	141	122	103
Mean,	2.93	-	-	-	-	-	-	-	-	-	-	-	-	-

Casual Phenomena. — Dates.

1892.	Thunder-storms.	Solar Halos.	Lunar Halos.	Aurora.
January,	- -	10,	10,	5.
February,	- -	19,	10,	13, 23, 26.
March,	- -	5, 16, 17, 22,	17,	6, 24, 25.
April,	- -	3, 5, 7, 8, 14, 15, 25,	3, 5, 7,	23, 24, 25, 26, 29.
May,	4,	1, 4, 5, 17, 26,	-	18.
June,	14, 17, 23, 30,	8, 10, 11, 13, 14, 29,	-	- -
July,	3, 13, 14, 16, 22, 23, 26, 28, 29,	22, 24,	4, 5,	- -
August,	4, 9, 11, 12, 19, 20, 26,	- -	6,	- -
September,	26,	4, 10, 19, 21,	3,	- -
October,	- -	15, 20,	-	- -
November,	- -	9, 29,	8,	4.
December,	- -	16, 20, 31,	27, 31,	- -

January, February, March, April.

	1891.	Date.	1892.	Date.
Mean temperature,	33.20°	-	31.43°	-
Absolute maximum temperature,	77.00°	April 30,	76.00°	April 5.
Absolute minimum temperature,	—5.50°	Feb. 15,	—10.00°	Jan. 17.
Mean monthly range,	33.00°	-	18.84°	-
Total precipitation (inches),	16.08	-	9.74	-
Total snowfall (inches),	58.00	-	34.00	-
Last snowfall,	-	April 3,	-	April 10.
Prevailing wind,	N. E.	-	N. E. & N. W.	-

May, June, July, August.

	1891.	Date.	1892.	Date.
Mean temperature,	63.65°	-	65.32°	-
Absolute maximum temperature,	90.00°	Aug. 11,	94.50°	June 14.
Absolute minimum temperature,	25.00°	May 1,	30.00°	May 1.
Mean monthly range,	25.25°	-	21.21°	-
Last frost,	-	June 25,	-	May 10.
Total rainfall (inches),	15.16	-	17.97	-
Prevailing wind,	N. E	-	S.W.	-

September, October, November, December.

	1891.	Date.	1892.	Date.
Mean temperature,	46.00°	-	43.28°	-
Absolute maximum temperature,	89.00°	Sept. 18,	79.00°	Sept. 18, 19, 25.
Absolute minimum temperature,	4.00°	Nov. 30,	—1.00°	Dec. 27.
Mean monthly range,	35.05°	-	18.47°	-
First frost,	-	Oct. 10,	-	Sept. 30.
Total precipitation (inches),	11.31	-	7.50	-
First snowfall,	-	Nov. 26,	-	Oct. 5.
Total snowfall (inches),	1.50	-	5.43	-
Prevailing wind,	S. E.	-	N. W.	-

Entire Year.

	1891.	Date.	1892.	Date.
Mean temperature,	47.62°	-	45.68°	-
Total precipitation (inches),	42.58	-	35.21	-
Total snowfall (inches),	59.50	-	39.43	-

ANNUAL REPORT OF C. A. GOESSMANN,

Treasurer of the Massachusetts Agricultural Experiment Station,

For the Year ending Dec. 20, 1892.

Received.		
Cash on hand from last year,	$3 31	
Cash from State Treasurer, appropriation,	10,000 00	
Cash from State Treasurer, Columbian Exhibition,	150 00	
Cash from fertilizer account,	2,310 00	
Cash from dairy bureau,	628 50	
Cash from farm,	1,014 14	
		$14,131 95
Expended.		
Cash paid salaries,	$3,927 51	
Cash paid laboratory supplies,	579 04	
Cash paid printing and office expenses,	576 45	
Cash paid farmer and farm labor,	2,254 96	
Cash paid farm supplies,	1,749 21	
Cash paid dairy bureau account,	402 06	
Cash paid fertilizer account,	2,304 50	
Cash paid construction and repairs,	774 56	
Cash paid expense of Board of Control,	152 34	
Cash paid incidental expenses,	589 66	
Cash paid library,	358 99	
Cash on hand,	462 67	
		$14,131 95

Summary of the Property of the Massachusetts State Agricultural Experiment Station (Dec. 31, 1892).

Farm.		
Live stock,	$628 88	
Tools, implements and machinery,	996 80	
Produce on hand,	832 60	
Fertilizers,	31 60	
Chemical Laboratory:		
Laboratory inventory,	3,005 27	
Office furniture, library, etc.,	1,978 50	
Agricultural and Physiological Laboratory:		
Furniture, herbariums, library (first floor),	734 35	
Instruments, apparatus, etc. (first floor),	761 20	
Furniture (second floor),	409 52	
Instruments, apparatus, etc. (second floor),	412 40	
Buildings, land, etc.,	32,202 00	
Total of inventory,		$41,993 12

This is to certify that I have examined the books and accounts of Charles A. Goessmann, Treasurer of the Massachusetts Agricultural Experiment Station, for the fiscal year ending Dec. 31, 1892, and find them correct, and all disbursements properly vouched for, with a balance in the treasury of four hundred and sixty-two sixty-seven one-hundredths dollars, which is shown to be in the bank.

WM. R. SESSIONS,
Auditor.

Jan. 10, 1893.

LIST OF EXCHANGES.

Reports and Bulletins of the United States Department of Agriculture, Washington, D. C.
Reports and Bulletins of the Agricultural Experiment Stations of the United States.
Bulletin of the State Board of Agriculture, Boston, Mass.
Bulletin of the Massachusetts Horticultural Society, Boston, Mass.
The American Cultivator, Boston, Mass.
The Holstein-Friesian Register, Boston, Mass.
Massachusetts Ploughman, Boston, Mass.
New England Farmer, Boston, Mass.
New England Homestead, Springfield, Mass.
The Home and Mart, East Boston, Mass.
New York Weekly World, New York, N. Y.
German Agricultural Horticultural Journal (German), New York, N. Y.
American Agriculturist, New York, N. Y.
The Rural New Yorker, New York, N. Y.
The Florists' Exchange, New York, N. Y.
Vick's Magazine, Rochester, N. Y.
The American Analyst, New York, N. Y.
The Rural Critic, Garratsville, N. Y.
Naturalist Monthly Bulletin, Philadelphia, Pa.
The Practical Farmer, Philadelphia, Pa.
The Farm Journal, Philadelphia, Pa.
The National Stockman and Farmer, Pittsburg, Pa.
Maryland Farmer, Baltimore, Md.
Baltimore Weekly Sun, Baltimore, Md.
The Agricultural Epitomist, Indianapolis, Ind.
The New Agricultural Era, Indianapolis, Ind.
The Orange Judd Farmer, Chicago, Ill.
The Western Swineherd, Geneseo, Ill.
The Monist, Chicago, Ill.
German Agricultural and Horticultural Journal, Chicago, Ill.
Detroit Free Press (weekly), Detroit, Mich.

Farmers' Home Weekly, Dayton, O.
American Grange Bulletin, Cincinnati, O.
Journal of the Columbus Horticultural Society, Columbus, O.
The Louisiana Planter, New Orleans, La.
The Wisconsin Farmer, Madison, Wis.
The Weekly Journal, Sioux City, Ia.
Western Farmer and Stockman, Sioux City, Ia.
Hospoda (Bohemian journal), Omaha, Neb.
The Industrialist, Manhattan, Kan.
The Home and Farm, Louisville, Ky.
The Industrial American, Lexington, Ky.
Southern Cultivator, Atlanta, Ga.
West American Scientist, Los Angeles, Cal.
California Cultivator and Poultry Keeper, Los Angeles, Cal.
Mirror and Farmer, Manchester, N. H.
Journal of the Elisha Mitchell Scientific Society, Chapel Hill, N. C.
The Journal of Agriculture, Montreal, Can.
Bulletins of the Central Experiment Farm, Ottawa, Can.
Bulletins of Department of Agriculture, New South Wales, Australia.
Bulletins of Department of Agriculture, Brisbane, Queensland.
Relatorio Annual da Estacao Argonomica de Campinas, Sao Paulo, Brazil.
Ragguagli, Laboratorio Chimico Agrario di Bologna, Bologna, Italy.
Reglamento, etc., Estacion Agronomica del Instituto Agricola de Alfonso XII., Madrid, Spain.

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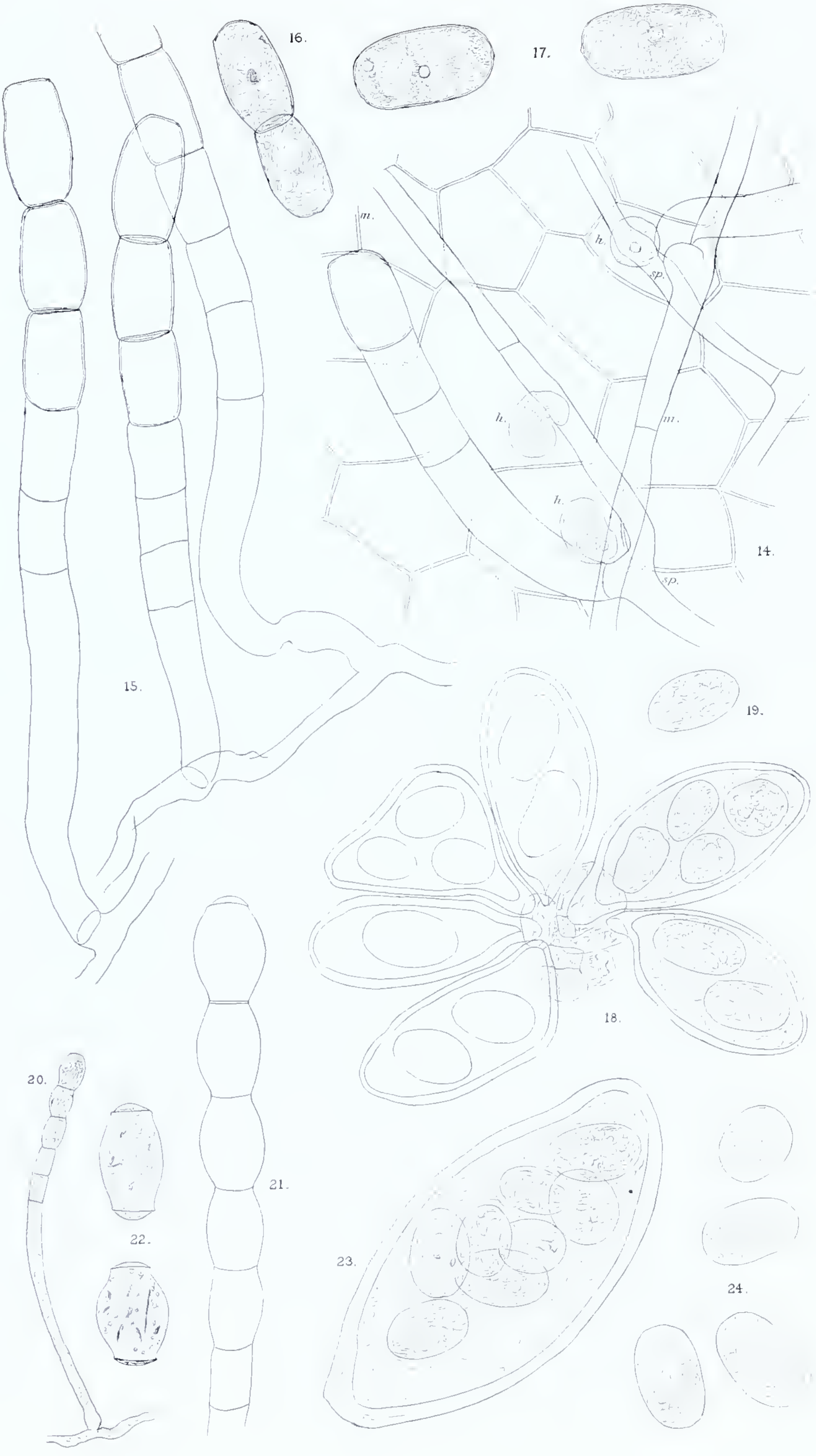
SCLEROTIUM DISEASE OF CUCUMBER.

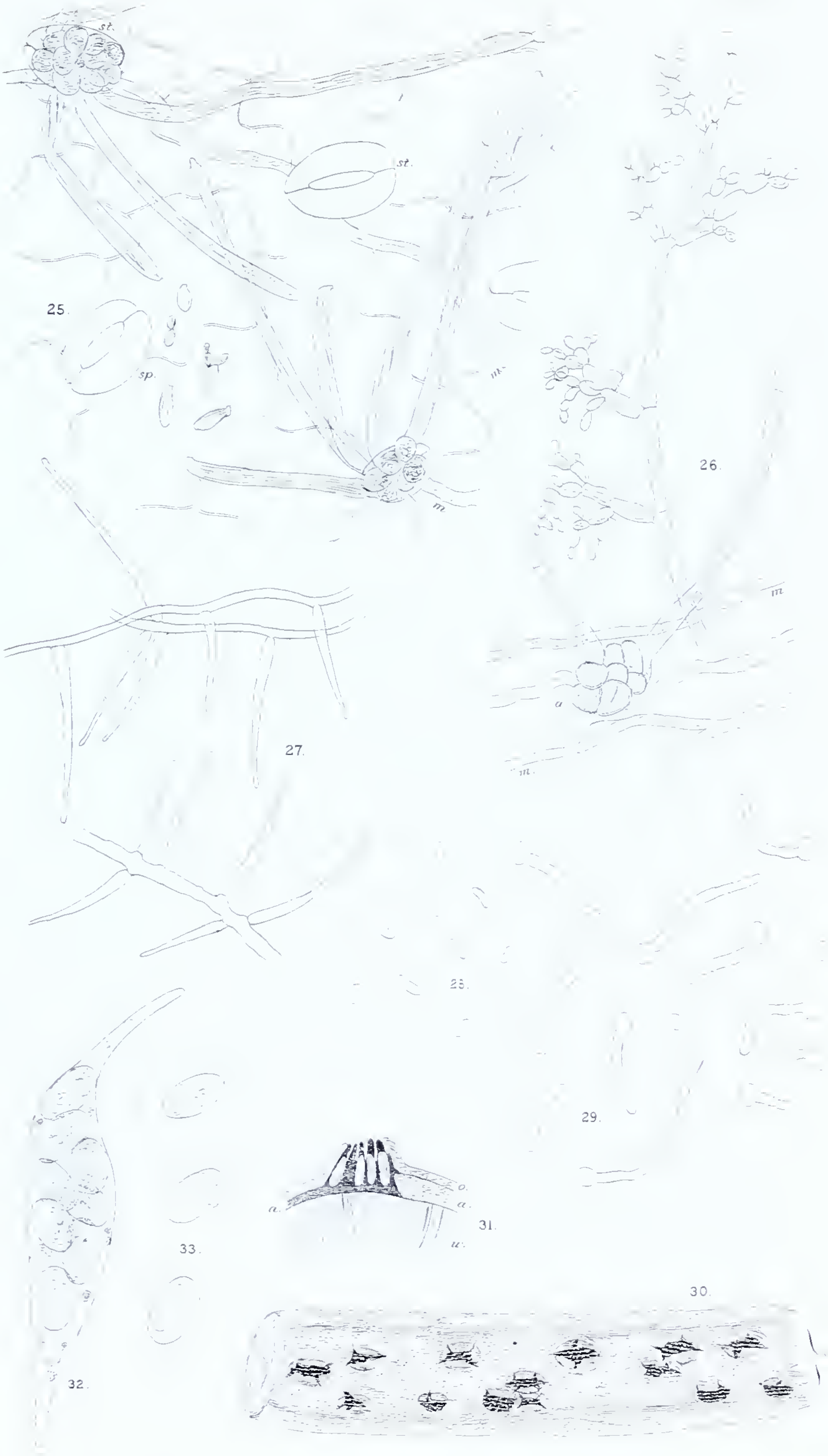
SCLEROTIUM DISEASE OF CUCUMBER



Humphrey, del.

POWDERY MILDEWS

PLATE I.



Hemsing, del.

CUCUMBER DISEASES. — HAZEL FUNGUS

BLACK KNOT OF PLUM.